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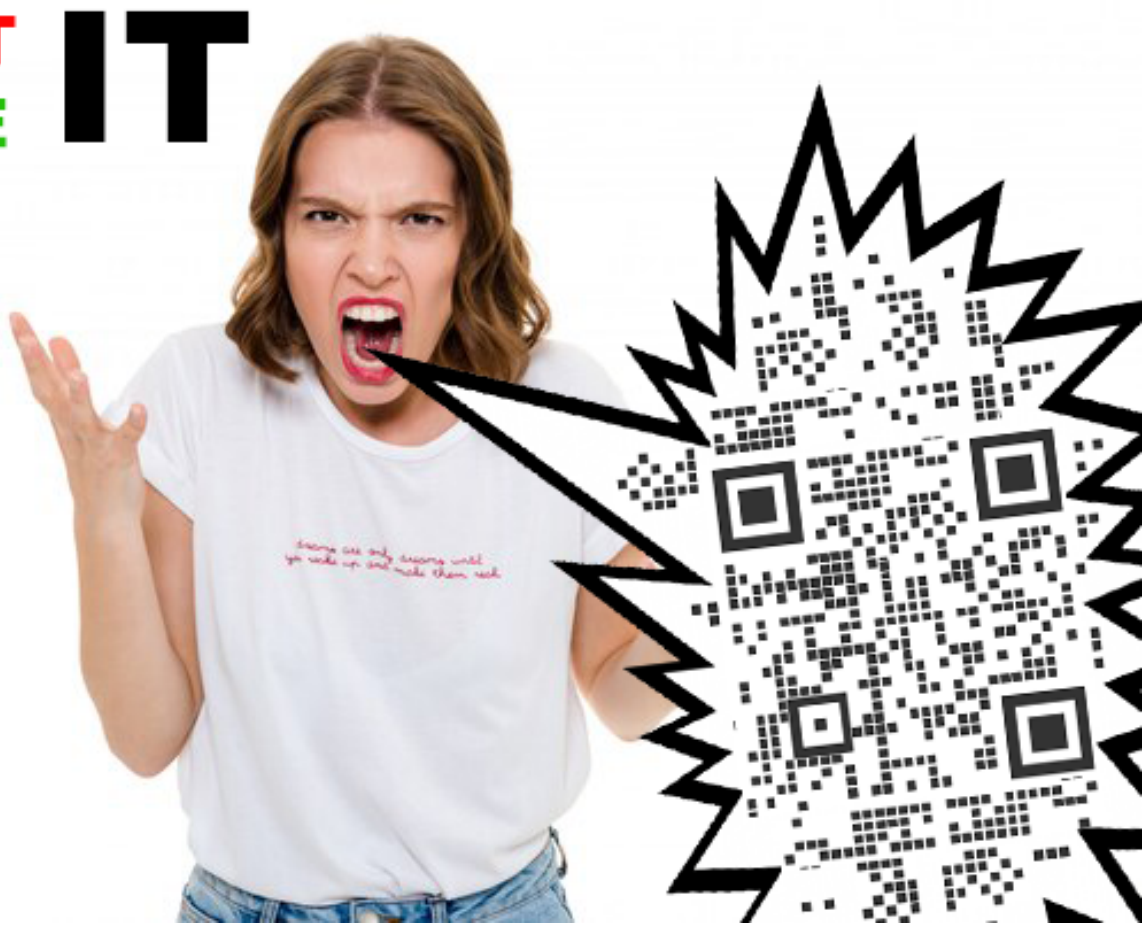

BULLETIN

OF THE

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

1899

NUMBERS 60 TO 68

AND

ELEVENTH ANNUAL REPORT

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS
DURHAM

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Bulletin 60 January, 1899

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

GREEN CORN UNDER GLASS

BY F. WM. RANE

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS
DURHAM

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

DURHAM

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BULLETINS OF 1898

Bulletin 49—Inspection of Fertilizers. January.
Bulletin 50—Dehorning Cattle. February.
Bulletin 51—Sweet Corn in New Hampshire. March.
Bulletin 52—Growing Muskmelons in the North. April.
Bulletin 53—The Farm Water Supply. May.
Bulletin 54—The Winter Food of the Chickadee. June.
Bulletin 55—The Feeding Habits of the Chipping Sparrow. July.
Bulletin 56—Poisonous Properties of Wild Cherry Leaves. August.
Bulletin 57—Experiments with Roots and Forage Crops. September.
Bulletin 58—Cost of Raising Calves. October.
Bulletin 59—Tenth Annual Report. November.

The Bulletins of this Station are sent free to any resident of New Hampshire upon application.

FIG. 2.—Lettuce house in which the corn was forced. The center bed is well adapted for a corn crop.

FIG. 3.—A crop of sweet corn with ears formed. College greenhouse, 1897.

GREEN CORN UNDER GLASS

BY FRANK WM. RANE

The forcing of sweet corn is practically unknown. That this crop can be grown under glass and if properly handled be profitable, I believe we are able to demonstrate. The idea that it was possibly adapted for forcing occurred to the writer when studying the root development of corn under glass. The corn grown at this time surprised us by its developing very fair sized nubbins under what might be termed very unfavorable conditions.

During the season of 1896-7, the only house available for the experiment was a large vegetable house, 25 x 100 feet; and as lettuce, cauliflower, etc., which demand a low temperature, are grown in this house during the fore part of the season, the sweet corn was not planted until April, when these crops were marketed.

The nature of the greenhouse is very important, as it is necessary that the plants have sufficient room for development. The house ordinarily used for lettuce and cucumbers in New England answers very well, while those filled with benches would not do. The plants vary according to the variety from four to eight feet in height. The house used in the present experiment has ground-floor beds, as shown in the photographs, and the center bed, which is 15 x 88 feet, is six feet from the glass at its nearest point, while the average is seven and one-half feet. The corn was planted April 10 and matured July 6. While we have not grown an extensive crop in midwinter, our results from the corn fruited in experimental boxes lead us to believe that with proper culture an entire house devoted to this crop would be highly successful.

Sweet corn does not appear in the Boston market until about

the middle of July. At that time it brings good prices and the entire product is from the south. In order to test the market a small shipment was made to a leading commission house in Boston on July 6, 1897. Its value could not be definitely determined, however, since owing to the fact that it was not on the market, there was no fixed price. The only quotations and data relating to sweet corn we have found, have been the following, taken from the files of *Garden and Forest*. They are for the New York wholesale market for the past five years:

June 24, 1893. "Green corn from the south is 60 cents a dozen ears."

July 4, 1894. "Green corn is in the market from New Jersey."

June 19, 1895. "The first Lima beans of the season are now coming from Florida and sugar corn is also received from the same state."

June 24, 1896. "Corn is now coming from southern New Jersey and costs fifty cents a dozen."

June 30, 1897. "Special consignments of small lots of sugar corn have been received from the south for a month past, but these have been sold directly to a few of the best hotels, and not opened up in the market at all. On last Saturday the first corn from Delanco, New Jersey, sold in Washington market at sixty cents for a dozen ears."

From this it is readily seen that if the New York market does not get sweet corn until these dates, Boston and other Northern cities are likely to be without it until much later. Without any sweet corn on the market therefore before July, we have a rather long period even in spring, when this vegetable has no competition. While it has no established market price at present in our cities, it naturally follows that like other forced greenhouse crops, the returns should at least be in proportion to its cost, and doubtless until commonly grown would be much more profitable. Sweet corn when first in season is doubtless as highly prized as any other of the green vegetables; and taking this fact into consideration, we believe that when offered out of season it will be in great demand.

FIG. 4.—Varieties.

10. Early Minnesota.
13. Crosby's Early.
14. White Cob.
15. First of All.
26. Early Fordbrook.
31. Adams's Extra Early.

THE HOUSE, AND METHODS OF TREATMENT

The House.—A house adapted to the growing of cucumbers or tomatoes trained to one stem, should grow sweet corn. The ordinary New England lettuce-house therefore answers admirably for this purpose. The plants being tall, ranging from three and one-half to eight feet according to variety, need considerable space overhead. A house capable of holding the temperature of 75° or higher during the day, and not below 60°, or better, 70° at night, is desirable. Even out of season corn demands its summer conditions in order to get best results. It does not, however, seem to be as tender and as easily checked as other plants, such as the egg-plant, melons, etc. It needs all the sunlight; therefore the glass needs no shading.

Fig. 2 is a photograph taken of the house used in this experiment. It was taken when the first crop of lettuce was coming off the present season.

Soil.—Any good fertile greenhouse soil will be favorable for sweet corn. Unlike many of the more delicate plants, it is a ravenous feeder provided other conditions are favorable. The soil in which our plants were grown was that mixed and used for forcing head lettuce,—a rather light sandy loam, with which all greenhouse men are acquainted. For the novice I would recommend a visit to a house forcing head lettuce, or he may find full directions in literature on forcing. After two crops of lettuce had been taken off, the corn was planted without supplying further plant food.

Our beds are on the ground and therefore much deeper than the ordinary raised bed, although we renew only about the same depth of soil from year to year, usually used in the raised ones. Ordinarily it probably would be advisable to add and mix in well some complete fertilizer. After a study of the development of corn roots, I am convinced that the plant will not suffer for food as long as there is any available about it.

Sowing and Transplanting.—Much time is gained by soaking the seed before planting as in this way they germinate more quickly. Should space be very scarce or the crop preceding rather late, the corn may be started in flower-pots and then transplanted. Care should be exercised, however, in so

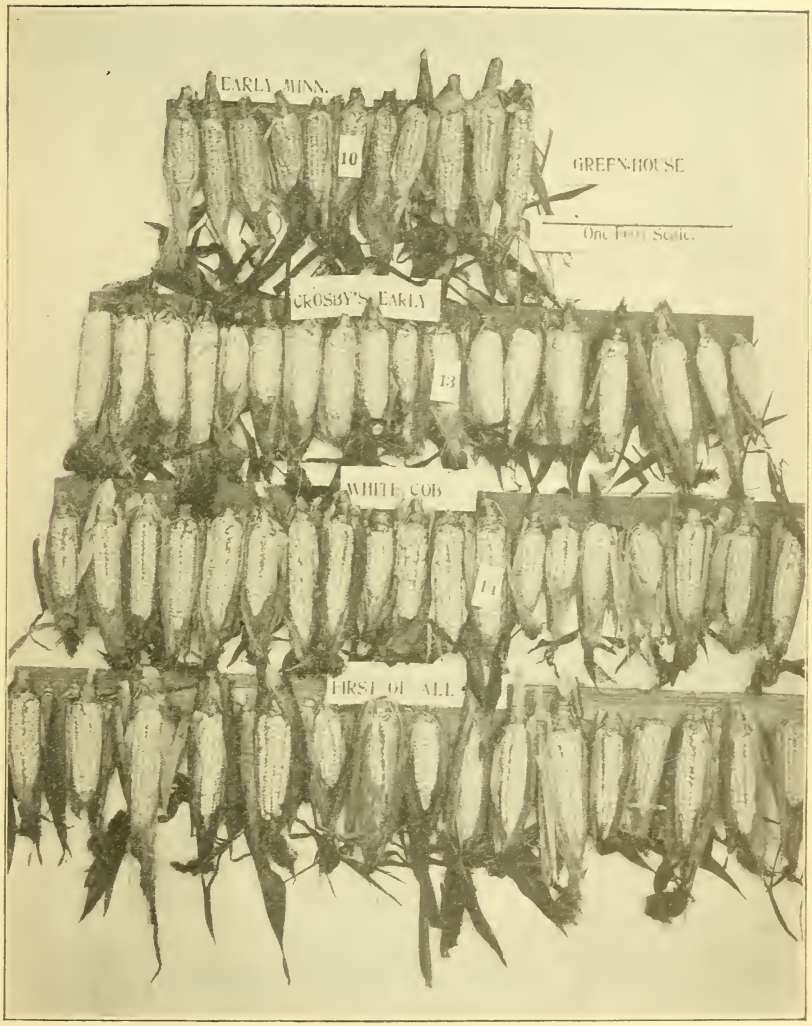


FIG. 5.—Average size and appearance of four of the varieties.

doing; for should the plant become root-bound, it will be stunted. They should be shifted from smaller to larger pots should occasion require it. A corn plant, if left in a four-inch pot, will tassel out when two feet or so tall. Only plants that have made a healthy growth from the first are likely to give satisfactory results.

Distance to Plant.—As space under glass is valuable, it follows that all of it must be utilized as far as possible. The usual distance out of doors for average sweet corn is in rows three feet apart, and the plants nine inches apart in the row. An experiment was undertaken at the time of planting to determine the most economical distance for planting in the forcing-house. Six plots were planted as follows: In plots 1 and 2, the rows were 18 inches apart; in plots 3 and 4, rows 2 feet apart; in 4 and 5, rows 3 feet apart. All of the plants were nine inches apart in the row. At maturity it was found that from plots 1 and 2, the plants averaged one ear per stalk; from 3 the average was .9 ears per stalk; from 4, one ear; and from 5 and 6 only .8 ears. Not only were there more ears from those plots with rows 18 inches apart, but they were equally as large and well filled. The silk formed on almost every plant for a second ear but with no results excepting in two instances.

A plot was also planted with the rows only one foot apart, and plants six inches apart in the row. This resulted in either no ears at all or a mere nubbin. The cut on the cover of the bulletin shows the twelve best ears out of the whole plot, only four of which approached edible size. The forcing-house runs nearly north and south, and the rows were made crosswise, or nearly east and west.

Training.—The only training thought necessary was to check the suckers which seem to start out very early in some of the varieties. These were easily pinched off or cut out, thus throwing the strength to the main stalk. We also found that it is unnecessary to allow all the tassels to remain on in order to secure sufficient pollen; one-half could easily be dispensed with. In so doing more strength would be thrown to the ear.

Pollinating.—Sweet corn grown under glass readily pollinates itself; the only thing necessary is that the atmosphere be

not too moist when the pollen is ripe. In this respect this crop is little care compared with many others which require usually considerable hand labor in order to set the fruit. In order to insure perfect pollination one can go over a house in a very short time by simply cutting a tassel here and there, and dusting the same upon the silk. It is doubtful, however, if this is needed.

Time to Maturity.—This will vary according to the variety as well as the temperature and general culture given. Of the three varieties under general test, all of which were planted under similar conditions on April 10, the first ear of edible size was from White Cob on July 1. Crosby's Early came next on July 4, and First of All at the same time, making for White Cob 83 days, and the other two 86 days, from seed. For general picking, however, July 6 was the first date, at which time about all the ears of each variety were ready, making 88 days. By keeping a high temperature and devoting a whole house to corn, it is believed that this crop could be harvested in a much shorter period. It usually takes from twelve to fifteen weeks to mature lettuce from seed. While of course corn requires more space in the house, it is readily seen that it can be grown with as quick results; also, were we able to produce two ears per plant, an ear of corn would represent the product from about the same space that a head of lettuce occupies.

Utilizing the Space Between the Rows.—While the corn is young, and until it is six weeks old, at which time it averages 21 inches in height, the space between the rows may be utilized with other so-called catch crops. After this time the corn begins to shade the ground and absorb the light necessary to plant growth. A number of different kinds of crops were planted between and in the rows in order to determine which could be grown to advantage with the corn. Those tested were radishes, lettuce, spinach, bush beans, dwarf tomatoes, and dwarf peas.

The radishes were very fine, and produced a crop fully equal to those grown in a bed by themselves. The varieties used were the Leafless and Rapid Forcing.

The open head Grand Rapids lettuce was found to be the best adapted for forcing with the corn, although the Boston

FIG. 6.—Concentration on small areas; various catch crops between the corn.

Market heading made a fine growth, and six weeks after transplanting started to head. The temperature was too high, however, for best results with this variety. The plants were set 8 x 8 inches, and covered the ground.

The spinach was ready to harvest on May 24, just 44 days from time of planting. This crop, however, does not make enough bulk to pay for growing, compared with either radishes or lettuce.

Bush beans, the seed of which was planted between the rows at the same time with the corn, were in bloom and 14 inches high on May 24, maturing for picking on June 15.

The Dwarf Aristocrat tomatoes were planted between rows of corn set three feet apart, and allowed to take their natural shape, pruning only to keep in bounds. On May 24 they were 20 inches tall and full of blossom. Considerable fruit set, but from lack of sunlight it failed to mature as early as it would have done under more favorable conditions.

The peas were also planted between the wider rows of corn. The variety used was Knott's Excelsior. They were of slow growth, and did not mature fruit until June 8. The yield was extremely light and far from profitable. The variety may have something to do with this.

The space may also be utilized for placing pots in starting melons, etc., for early transplanting out of doors.

Insects, Fungus, and Pests.—No insects seemed to bother the sweet corn when grown under glass. One stalk of corn developed smut, which was cut out before it matured. The worst trouble is liable to come from rats and mice. After they once get a taste of corn they persist in being troublesome until they are gotten rid of. Both dig out the corn when young, and the rats in a few cases attacked the growing corn.

VARIETIES

The varieties we have tested have been the Early Minnesota, Crosby's Early, White Cob, First of All, Early Fordhook, and Adams's Extra Early. All of these are grown to some extent in New England, and are popular generally. The Early Minnesota, Early Fordhook, and Adams's Extra Early were grown under less favorable conditions than the others. A specimen

of each variety is shown in Fig. 4, which represents their comparative heights and general appearance. The stalks grew taller, if anything, than they do in the garden in every case. The Adams's Extra Early was grown on account of its earliness regardless of its flavor. This variety is not a true sweet corn, but its merits are earliness and productiveness. The three varieties grown for the main crop, and upon which the data for this bulletin chiefly depend, are the Crosby's Early,

FIG. 7.—Radishes ready to pull between corn. (Bush Beans and younger radishes on the right).

White Cob, and First of All. A number of average ears of each of these is shown in Fig. 5.

No. 13, *Crosby's Early*.—This is a standard early white variety; average height under glass from 5 to 5½ feet. Good quality, and yielded at the rate of one ear to the stalk, all averaging as shown in Fig. 5; small cob; sends up numerous suckers. It ripens a few days later than any of the others but is very desirable for a market variety.

No. 14, *White Cob*.—In respect to height, yield, and general appearance, this variety was the same when grown in and

out of doors. One of the earliest; very dark green foliage, 5 feet high; numerous suckers; good-sized kernels, with small cob; good quality; many ears under size. Yield averaged almost one ear per stalk, running in size as shown in Fig. 5.

No. 15. *First of All.*—A new early to second early variety; ears good size and long; cob rather large; kernels medium sized; stalk averaged 5½ to 6 feet; quality fair. While one of the heaviest yielders out of doors, it fell behind in the greenhouse, producing at the rate of *eight-tenths* ears per stalk.

No. 26, *Early Fordhook.*—Not given a fair trial. Under more favorable circumstances we believe it would do well.

No. 10. *Early Minnesota.*—This variety was not as early as most of the others, taking a longer time than Crosby's Early.

From our experience with the above named varieties, I believe we can depend upon almost any variety that is desirable out of doors, to be equally valuable under glass. Moreover, if proper heat, moisture, and a rich soil be given, a crop will mature in the greenhouse in a shorter time than in the garden. In the forcing-house with the exception of light we can have almost ideal conditions. With the use of the electric light, even the cloudy weather of winter can be overcome to a degree.

For other varieties of sweet corn, we would ask the reader to consult BULLETIN No. 51. Two not in the test, which we believe are worthy of consideration for growing under glass are Early Beverly and Eastman's Early. Both were early and desirable in the garden.

If sweet corn proves to be a successful forcing-house crop, doubtless as with the muskmelon, tomatoes, cucumbers, etc., we can in a few years develop varieties that will be better adapted for this purpose than any of our present ones.

SUMMARY

1. Sweet corn should be included in the list of vegetables adapted for forcing under glass.

2. The requisites for forcing corn under glass are practically the same as those for forcing such plants as tomatoes, melons, cucumbers, egg-plants, etc.; a night temperature of not less than 60° to 70°, and ten degrees or more higher during day. Until pollen begins to fall the atmosphere of the house should be kept moist; the soil also should never become very dry.

3. The house adapted for forcing corn should have considerable space above the beds, ranging from $3\frac{1}{2}$ to $8\frac{1}{2}$ feet, according to the variety grown.

4. In order to be remunerative, the crop should be on the market before July, at which time the Southern product begins to arrive.

5. Any good, fertile greenhouse soil, containing plenty of available plant-food answers well for corn. Unlike many more delicate plants, when once established it is a ravenous feeder.

6. The extra early varieties mature in 83 days, while the standard early (Crosby) takes 86 days from seed.

7. When starting the plants in pots, precaution should be exercised, lest they become pot-bound. The 3-inch pots are good to start with, repotting into a 5- or 6-inch pot, and thence into the bed.

8. The stools or suckers should be pruned out, in order to throw the strength to one main stalk and its fruit. The tassels also may be thinned out, especially in spring fruiting, as there is an abundance of pollen produced at this time. For a winter crop it would probably not be advisable.

9. The varieties found to do very well were Crosby's Early, First of All, and White Cob. The White Cob was the earliest, but Crosby's Early was thought to be more desirable. Other varieties we believe well adapted to forcing are the following: Extra Early Beverly, Eastman's Early, and Early Fordhook. Varieties successfully grown in the garden seem to do equally well under glass.

10. An experiment for determining the proper distance to plant corn under glass, resulted in rows 18 inches apart, and 9 inches apart in the row.

11. During the early stages of growth a catch crop of radishes, Grand Rapids lettuce or other crops, can be taken off, or the space used for starting plants for transplanting into cold frames or the garden.

12. The only pests to contend with are rats and mice. Both persist in digging out the seed, and the rats attack the maturer corn, eating the more succulent parts and especially the ears. One of these rodents will do considerable damage in one night. Be sure to poison or destroy them before planting the crop.

Bulletin 61 February, 1899

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

THE INSPECTION OF FERTILIZERS IN 1898

IN CO-OPERATION WITH THE STATE BOARD OF AGRICULTURE

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS
DURHAM

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS. 1898

	Cents per pound.
Nitrogen in ammonia salts	14.
" nitrates	13.
" dry and fine ground fish, meat, and blood and in high grade mixed fertilizers	14.
Nitrogen in cotton-seed meal, linseed meal and castor-pomace	12.
Nitrogen in fine ground bone and tankage	13.5
" medium ground bone and tankage	11.
" coarse bone and tankage	8.
Phosphoric acid soluble in water	4.5
" " " ammonium citrate (reverted)	4.
" " in fine ground bone and tankage	4.
" " in medium ground bone and tankage	4.
" " in coarse bone and tankage	3.5
" " in fine ground fish, cotton-seed meal, linseed meal, castor-pomace, and wood-ashes	4.
" " insoluble in mixed fertilizers	2.
Potash as sulphate free from chlorides and in wood ashes	5.
" " muriate	4.25

The above values are based on the wholesale market price for the materials, when sold in large lots at the principal trade centers in New England. The valuation of a ton of any mixed fertilizer based on the above figures will usually fall ten dollars below the retail price at the local agency. This variation includes such fixed charges as cost of mixing, bags, cartage and freight, salaries and commissions of agents, and interest.

THE FERTILIZER INSPECTION IN 1898

This year, as in the past, the New Hampshire College Agricultural Experiment Station has coöperated with the State Board of Agriculture in an inspection of the commercial fertilizers sold in the state.

In accordance with the public statutes, the collection of samples of the different fertilizers has been in charge of the Secretary of the Board of Agriculture, Hon. N. J. Bachelder, who has been assisted by Mr. James A. Foord; while the chemical analyses have been performed under the direction of the chemist of the Experiment Station, Prof. Fred W. Morse, who has had for assistants, Messrs. Chas. D. Howard, Arthur Given, and Harry E. Barnard.

The work of the inspectors in this state cannot be finished before the farmers buy their season's stock of fertilizers, because the manufacturers do not, in many cases, place their goods in the hands of the local agents until April 1, or later. Consequently the analyses of the past year must serve as a guide to the composition of the fertilizers on the market for the coming year. The publication of this bulletin has therefore been delayed, with the idea that it will receive more attention now than if issued last fall, and thus be more effective in decreasing the use of inferior brands.

Under the present fertilizer law, a manufacturer pays a license fee, which permits the sale of as many different brands of fertilizers as he may choose to place on the market. The multiplication of brands by the different makers has required more analyses than could be paid for out of the license fees, therefore this year one-third of the samples collected were not analyzed. The brands included in this lot had been examined for two successive years, 1896 and 1897, and found to be equal to their respective guarantees in all respects.

The list is published in order that all brands found by the

agent of the Board of Agriculture may be included in this report, and that their guarantees may be compared by those farmers who may wish to select a fertilizer on the basis of its percentage composition.

LIST OF TOWNS VISITED BY THE AGENT OF THE BOARD OF AGRICULTURE

Newton	Rockingham County
Exeter	" "
Portsmouth	" "
Kingston	" "
Candia Village	" "
Auburn	" "
Silver Lake	Carroll "
Farmington	Strafford "
Dover	" "
Gilmanton Iron Works	Belknap "
Laconia	" "
Lakeport	" "
Tilton	" "
Pittsfield	Merrimack "
Bradford	" "
Concord	" "
Manchester	Hillsborough "
New Boston	" "
Mont Vernon	" "
Greenville	" "
Nashua	" "
Troy	Cheshire "
Keene	" "
Newport	Sullivan "
Cornish Centre	" "
Cornish Flat	" "
Canaan	Grafton "
West Canaan	" "
Canaan Center	" "
Hanover	" "
Littleton	" "
South Littleton	" "
Colebrook	Coös "
West Stewartstown	" "

LIST OF MANUFACTURERS

Armour Fertilizer Works.
Bowker Fertilizer Co.
Bradley Fertilizer Co.
Baugh & Sons Co.
Clark's Cove Fertilizer Co.
Cumberland Bone Phosphate Co.
Cleveland Dryer Co.
Crocker Fertilizer and Chemical Co.
L. B. Darling Fertilizer Co.
E. Frank Coe Fertilizer Co.
Great Eastern Fertilizer Co.
Lister's Agricultural Chemical Works.
Lavery Fertilizing Co.
Lowell Fertilizer Co.
Manchester Slaughtering and Rendering Co.
Packers' Union Fertilizer Co.
Pacific Guano Co.
Parmenter & Polsey Fertilizer Co.
Quinnipiac Company.
Read Fertilizer Co.
Russian Cement Co.
Henry F. Tucker Co.
Standard Fertilizer Co.
Williams & Clark Fertilizer Co.

COMPOSITION OF MIXED FERTILIZERS COLLECTED BY THE STATE BOARD OF AGRICULTURE, 1898.

Number.	Manufacturer and Brand.	Nitrogen in 100 Lbs.		Phosphoric Acid in 100 Lbs.							Potash in 100 Lbs.	
							Total.		Available.			
		Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Baugh & Sons Co.											
1	Baugh's General Crop Grower	1.12	.82	5.68	3.27	1.15	10.10	.....	8.95	8.00	1.49	1.00
2	Baugh's Special Potato Manure	1.67	1.65	4.72	1.83	1.84	8.39	7.50	6.55	5.00	9.53	10.00
3	Economical Fertilizer	2.10	1.65	5.05	3.17	3.34	11.56	.....	8.22	7.00	2.28	2.00
4	Twenty-five Dollar Phosphate	2.35	2.06	5.69	3.50	2.71	11.90	.....	9.19	7.00	0.90	.50
	Bowker Fertilizer Co.											
5	Bowker's Bone, Blood, and Potash	3.92	4.00	3.56	4.29	4.15	12.00	12.00	7.85	8.00	7.41	7.00
6	Granite State Fertilizer	1.88	1.00	4.57	2.66	3.66	10.89	10.00	7.23	7.00	7.03	6.00
7	Bowker's Potato and Vegetable Phosphate	1.61	1.50	5.87	2.42	2.94	11.23	10.00	8.29	8.00	2.32	2.00
8	Stockbridge Manure for Corn, Grain, and Fodder Corn	3.08	3.00	5.63	2.44	2.96	11.03	10.00	8.07	7.00	7.81	7.00
9	Bowker's Special Fertilizer for Potatoes and Vegetables	2.21	2.25	6.72	2.47	1.34	10.53	10.00	9.19	8.00	4.63	4.00
60	Bowker's Hill and Drill Phosphate	2.15	2.25	6.63	2.54	3.48	12.65	12.00	9.17	9.00	2.57	2.00
	Bradley Fertilizer Co.											
10	Bradley's Eclipse Phosphate	1.65	1.00	5.63	3.63	3.10	12.36	12.00	9.26	10.00	1.77	1.50
11	Bradley's Grass Manure for Top-dressing	4.04	3.91	4.03	1.20	1.08	6.31	6.00	5.23	5.00	2.50	2.00
12	Bradley's Seeding-down Manure	2.59	2.50	6.59	3.44	1.97	12.00	12.00	10.03	7.00	2.36	2.00
13	Original Coe's Superphosphate	2.13	2.05	5.44	3.53	2.76	11.73	10.00	8.97	8.00	1.78	1.00
14	English Lawn Fertilizer	4.50	4.95	2.94	3.62	1.64	8.20	6.00	6.56	5.00	3.26	2.50

15	Bradley's Complete Manure for Potatoes and Vegetables	3.50	3.30	3.45	4.69	2 99	11.13	9.00	8.14	8.00	7.17	7.00
16	Bradley's Complete Manure for Corn and Grain	3.37	3.30	5.31	6.13	2.40	13.84	13.00	11.44	12 00	3.15	3.00
	CLARK'S COVE FERTILIZER CO.											
17	King Philip Alkaline Guano	1.12	1.00	6.10	3.96	1.80	11.86	9.00	10.06	8.00	2.60	2.00
	CLEVELAND DRYER CO.											
18	Cleveland Superphosphate	2.14	2.05	5.88	3.36	2.78	12.02	11.00	9.24	9.00	2.01	2.00
	L. B. DARLING FERTILIZER CO.											
19	Darling's New Hampshire Special	3.59	3.00	4.52	4.57	0.92	10.01	10.00	9.09	8.00	8.45	8 00
20	Darling's Special L. I. C. Brand	4.20	4.12	2.70	2.71	3.84	9.25	8.00	5.41	7.00	10.15	10.00
	E. FRANK COE CO.											
21	E. Frank Coe's Prize Brand Grain and Grass Fertilizer	0.56	.40	6.52	4.18	3.96	14.66	12.00	10.70	10.50	1.85	1.25
22	E. Frank Coe's Celebrated Special Potato Fertilizer	1.62	1.65	6.40	2.19	2.94	11.53	10.00	8.59	8.00	4.15	4.00
23	E. Frank Coe's Columbian Bone Superphosphate	1.49	1.20	7.42	2.45	3.12	12.99	11.00	9 87	9.00	2.45	1.85
	GREAT EASTERN FERTILIZER CO.											
24	Great Eastern Northern Corn Special	3.13	2.88	0.77	7.20	1.87	9.81	9.00	7.97	8.00	2.80	2.00
25	Great Eastern General Fertilizer	1.07	.82	0.64	7.19	1.85	9.68	9.00	7.83	8.00	4.95	4.00
	LAVERY FERTILIZER CO.											
26	Lavery Fertilizer Co. Superphosphate	2.45	1.95	1.54	8.60	1.12	11.26	.....	10.14	10.00	0.56	2.35
	LOWELL FERTILIZER CO.											
27	Swift's Lowell Potato Phosphate	2.75	2.47	6.09	1.80	1.83	9.72	9.00	7.89	8.00	6.33	6.00
28	Swift's Lowell Bone Fertilizer for Corn and Grain	1.84	1.65	6.17	1.89	1.82	9.88	9 00	8.06	8.00	3.30	3.00
29	Swift's Lowell Fruit and Vine for Strawberries.	3.54	3.29	6.71	2.69	1.26	10.66	9.00	9.40	8.00	5.58	6.00

COMPOSITION OF FERTILIZERS COLLECTED BY THE STATE BOARD OF AGRICULTURE, 1898.—*Continued.*

Number.	Manufacturer and Brand.	Nitrogen in 100 Lbs.		Phosphoric Acid in 100 Lbs.							Potosh in 100 Lbs.	
							Total.		Available.			
		Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Lowell Fertilizer Co.—*Continued.*											
30	Swift's Lowell Garden Manure	3.70	4.10	5.50	1.75	1.70	8.95	8.00	7.25	7.00	5.55	5.00
31	Swift's Lowell Animal Brand for General Use	2.53	2.46	7.67	1.48	2.06	11.21	10.00	9.15	9.00	5.72	4.00
32	Swift's Lowell Ground Bone	1.97	2.47	.....	10.40	18.80	29.20	23.00	10.40	.....	.....	.....
59	Swift's Lowell Dissolved Bone and Potash	1.85	1.65	5.53	4.10	2.10	11.73	10.00	9.63	9.00	2.61	2.00
33	Swift's Lowell Lawn Dressing	3.29	4.11	5.47	3.44	2.64	11.55	8.00	8.91	7.00	5.93	5.00
	Manchester Slaughtering and Rendering Co.											
34	Tankage	5.00	.....	.....	6.07	12.57	18.64	.....	6.07	.....	.....	.....
	Parker's Union Fertilizer Co.											
35	High Grade Wheat, Oats, and Clover Fertilizer	.....	.....	6 39	6.29	2.30	14.98	.....	12.68	11 00	1.94	2.00
36	High Grade Gardner's Complete Manure	2.59	2.47	6.00	3.55	1.30	10.85	10.00	9.55	8.00	8.65	10.00
	Pacific Guano Co.											
37	Potato Special	1.95	2.06	4.36	4.52	2.34	11.22	9.00	8.88	8.00	3.30	3.00
	Parmenter and Polsey Fertilizer Co.											
38	Dissolved Bone	1.60	1.65	2.29	14.18	4.80	21.27	20.00	16.47	15.00	.....	.....

39	Muriate of Potash									50.38	50.00
65	Plymouth Rock Brand Fertilizer	2.89	2.47	2.54	6.17	2.32	11.03	9.00	8.71	8.00	4.18	4.00
	READ FERTILIZER CO.											
40	High Grade Farmer's Friend	3.18	3.25	3.63	1.05	2.50	7.18	6.00	4.68	5.00	10.63	10.00
41	Sure Catch Fertilizer			2.95	4.59	0.64	8.18	7.00	7.54	6.00	4.23	4.00
42	Farmer's Friend Superphosphate	2.26	2.00	7.54	2.07	2.06	11.67	10.00	9.61	9.00	2.65	2.00
43	Samson's Fertilizer for Potatoes	1.86	1.65	4.27	2.07	1.78	8.12	7.00	6.34	6.00	4.74	4.00
44	Original Alkaline Bone			4.67	5.21	1.37	11.25	11.00	9.88	10.00	2.35	3.00
	RUSSIAN CEMENT CO.											
45	Essex XXX Fish and Potash	2.62	2.10	5.17	3.70	5.27	14.14	12.00	8.87	10.00	2.39	2.25
46	Essex Complete Manure for Corn, Grain, and Grass	4.04	3.70	4.93	2.09	4.25	11.27	9.50	7.02	7.00	10.02	9.50
47	Essex Complete Manure for Potatoes, Roots, and Vegetables	3.72	3.70	5.36	2.25	4.06	11.67	9.00	7.61	7.00	9.29	8.50
	HENRY F. TUCKER CO.											
48	Imperial Bone Superphosphate	1.17	1.25	6.16	1.90	2.12	10.18	11.00	8.06	9.00	2.47	1.85
49	Tucker's Special Potato Fertilizer	2.05	2.06	2.37	3.20	4.05	9.62	9.00	5.57	8.00	5.70	6.00
50	Tucker's Grass Manure	5.21	3.91	4.45	0.85	2.60	7.90	6.00	5.30	5.00	2.90	2.00
	STANDARD FERTILIZER CO.											
51	Standard Special for Potatoes	2.06	2.05	5.96	2.07	2.94	10.97	9.00	8.03	8.00	3.34	3.00
	WILLIAMS & CLARK FERTILIZER CO.											
52	Americus Corn Phosophate	2.10	2.06	5.25	3.89	3.24	12.38	10.00	9.14	9.00	1.94	1.50
53	Americus Potato Manure	2.06	2.06	5.90	2.66	3.32	11.88	9.00	8.56	8.00	3.14	3.00
54	Prolific Crop Producer	1.12	.82	3.83	2.06	4.54	10.43	7.00	5.89	6.00	1.47	1.00
	ARMOUR FERTILIZER WORKS.											
55	Armour's All Soluble	3.02	2.88	4.85	2.72	3.05	10.62	10.00	7.57	8.00	5.98	4.00
56	Armour's Ammoniated Bone with Potash	3.55	2.47	4.56	1.67	6.21	12.44	8.00	6.23	6.00	2.77	2.00
57	Armour's Grain Grower	2.94	1.64	5.80	2.15	4.91	12.86	10.00	7.95	8.00	2.66	2.00

COMPOSITION OF FERTILIZERS COLLECTED BY THE STATE BOARD OF AGRICULTURE, 1898.—*Continued.*

Number.	Manufacturer and Brand.	Nitrogen in 100 Lbs.		Phosphoric Acid in 100 Lbs.							Potash in 100 Lbs.	
							Total.		Available.			
		Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Crocker Fertilizer and Chemical Co.											
61	Crocker's Potato, Hop, and Tobacco Phosphate.	2.12	2.00	8.20	1.73	1.22	11.15	11.00	9 93	10.00	4.07	3.25
	Lister's Agricultural Chemical Works.											
62	Lister's Special Potato Fertilizer	1.77	1.65	6.87	1.54	2.72	11.13	9.00	8.41	8.00	3.28	3.00
	Quinnipiac Co.											
63	Quinnipiac Potato Phosphate	2.54	2.05	7.00	1 93	3.03	11.96	9.00	8.93	8.00	3.21	3.00
	Cumberland Bone Phosphate Co.											
64	Cumberland Potato Fertilizer	1.92	2.06	6.57	2.46	3.22	12.25	11.00	9.03	9.00	2.95	3.00

BRANDS OF FERTILIZERS SAMPLED BUT NOT ANALYZED.

Manufacturer and Brand.	Guarantee in 100 Lbs.			
		Phosphoric Acid.		
	Nitrogen.	Total.	Available.	Potash.
Bowker Fertilizer Co.				
Bowker's Square Brand Bone and Potash	1.50	12.00	6.00	2.00
Stockbridge Manure for Top-dressing	4.75	6.00	4.00	6.00
Stockbridge Manure for Potatoes and Vegetables	3.20	7 00	5.00	10.00
Bradley Fertilizer Co.				
Bradley's XL Superphosphate	2.50	11.00	9.00	2.00
Bradley's Corn Phosphate	2.06	10.00	9.00	1.50
Bradley's Potato Manure	2.50	8.00	6.00	5.00
Clark's Cove Fertilizer Co.				
Clark's Cove Potato Fertilizer	2.00	9.00	8.00	3.00
Cleveland Dryer Co.				
Cleveland Potato Phosphate	2.05	10.00	8.00	3.00
Crocker Fertilizer and Chemical Co.				
Crocker's New Rival Ammoniated Superphosphate	1.23	11.00	10.00	1.60
Crocker's Ammoniated Corn Phosphate	2.00	11.00	10.00	1.60
L. B. Darling Fertilizer Co.				
Darling's Potato and Root Crop Manure	2.88	10.00	9.00	7.00
Darling's Animal Fertiltzer	3.30	10.00	6.00	4.00
E. Frank Coe Co.				
E. Frank Coe's High Grade Ammoniated Bone Superphosphate	2.00	11.00	9.00	1.85
E. Frank Coe's Columbian Corn Fertilizer	1.00	11.00	9.00	1.85
E. Frank Coe's Columbian Potato Fertilizer	1.20	11.00	9.00	1.85
E. Frank Coe's Celebrated Special Grass and Grain Fertilizer	.80	10.00	9.00	1.35
Great Eastern Fertilizer Co.				
Great Eastern Grass and Oats Fertilizer		12.00	11.00	2.00
Great Eastern Potato Manure	2.06	9.00	8.00	4.00
Lister's Agricultural and Chemical Works.				
Lister's Success Fertilizer	1.24	11.50	9.50	2.00
Packers' Union Fertilizer Co.				
Packers' Union Animal Corn Fertilizer	2.47	9.00	8.00	2.00
Packers' Union High Grade Universal Fertilizer	.82	9.00	8.00	5.00

BRANDS OF FERTILIZERS SAMPLED BUT NOT ANALYZED.

Manufacturer and Brand.	Guarantee in 100 Lbs.			
		Phosphoric Acid.		
	Nitrogen.	Total.	Available.	Potash.
Pacific Guano Co.				
Soluble Pacific Guano	2.25	10.50	8.50	2.00
Quinnipiac Co.				
Quinnipiac Corn Manure	2.06	10.00	9.00	1.50
Quinnipiac Climax Phosphate	1.03	9.00	8.00	2.00
Read Fertilizer Co.				
Read's Standard Superphosphate	.83	9.00	8.00	4.00
Read's Practical Potato Special	.83	5.00	4.00	8.00
Read's Vegetable and Vine	1.65	7.00	6.00	8.00
Read's Fish, Bone, and Potash	2.50	5.00	4.00	4 00
Read's Leader Guano	.83	8.00	7.00	2.00
Henry F. Tucker Co.				
Tucker's Original Bay State	2.06	11.00	9.00	2.00
Standard Fertilizer Co.				
Standard Fertilizer	2.00	10.00	8.00	2.00

FRED W. MORSE,
Chemist.

Bulletin 62 February, 1899

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

FORCING
POLE BEANS UNDER GLASS

NESMYTH HALL, EXPERIMENT STATION BUILDING.

BY F. WM. RANE

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

DURHAM

FIG. 8.—Pole beans running on ordinary bean poles in greenhouse.

FORCING POLE BEANS UNDER GLASS

BY FRANK WM. RANE

The forcing of dwarf or bush beans under glass has been a favorite practice at certain seasons of the year with most gardeners. The forcing of the pole or running varieties, I have reason to believe, has never heretofore received attention.

During the winter season of 1896-'97 a first trial was made which proved fairly successful with one variety. The following season, 1897-'98, two more crops were grown, both of which proved very interesting and I believe of sufficient value to merit attention.

The pole bean, like cucumbers, tomatoes trained to one stem, sweet corn, etc., must have plenty of headroom or space above the bench or bed in which to develop. Doubtless this accounts for its not having been considered before. The modern lettuce and cucumber house with the beds directly on the ground are well adapted for this crop. The house described for sweet corn in Bulletin 60 of this station, of which a cut is also given, is well suited to force pole beans.

The soil should be well enriched, containing an abundance of available plant food. That used by us was a sandy loam composted by mixing equal parts of rich dark loam, sand, and manure. The beds were directly upon the ground and the prepared soil averaged about seven inches in depth. The subsoil was loosened up to about an equal depth before the other was put in, thus giving a seed bed of fairly good mechanical condition.

Sowing and Transplanting. By soaking the seed much time is gained on account of its earlier germination. It is usually an advantage also to start the seed in flower pots and from here to transplant into the permanent beds; in so doing the previous crop can be given more time and as space in a

forcing house is valuable, more is realized financially. The plants should not be allowed to become root-bound before transplanting, as the check or set back thus given materially lessens all chances for a crop.

The pole bean germinates so readily and begins to run in so short a time, if under favorable conditions, that we have not deemed it advisable to shift or transplant but once. We therefore start them in four- or six-inch pots, according to the length of time they are to remain in the same, and from these transplant directly into the beds. The time usually saved by so doing is from two weeks to a month, depending upon conditions; it usually takes from five to twelve days for the seed to germinate to begin with. Only plants that have made a healthy growth from the first are likely to give satisfactory results.

Training. Pole beans must have some kind of a support and this once arranged for they will take care of themselves. We have tried two methods,—one, the use of ordinary bean poles commonly resorted to out of doors, as is shown in Fig. 8; and for the other, wires were run along parallel with and directly over, the rows of beans at the proper height, which in our case was seven feet. Then a wooden peg with a notch cut near the top was driven in the bed at each hill, and to these pegs a string was fastened, running it over the wire at the top and down again, as is shown in Fig. 9. The advantage of the string over the pole is less shade and hence better results; also the overhead space is utilized to better advantage.

Pollination. The bean looks out for itself, happily for the grower; they are to all appearances self-fertile.

Varieties. Comparatively few varities have been tested, as our aim was not so much for this purpose as to study them as a class. The varieties of pole beans grown were, Lazy Wife, Mastiff Golden Pod, Golden Champion, Early Golden Cluster, and one variety of pole Lima beans, Seibert's Early. All of these have been grown in the garden and are fairly well-known.

1. Lazy Wife (Burpee). A dark green pod of medium size, —4 to 6 inches in length. It was about five days later than the other varieties in maturing and not so prolific.

3. Mastiff Golden Pod (Gregory, Novelty 1896). A wax bean, strong grower, good-sized pods, and a heavy yielder. While this variety is not the earliest to fruit, it continues to yield a large and profitable crop for a long period. Not only is this true but it out-yielded the others in the first fourteen days of bearing, representing the first three pickings.

4. Golden Champion (Coles). A wax variety, strong grower, large pods averaging 6½ inches in length. A good

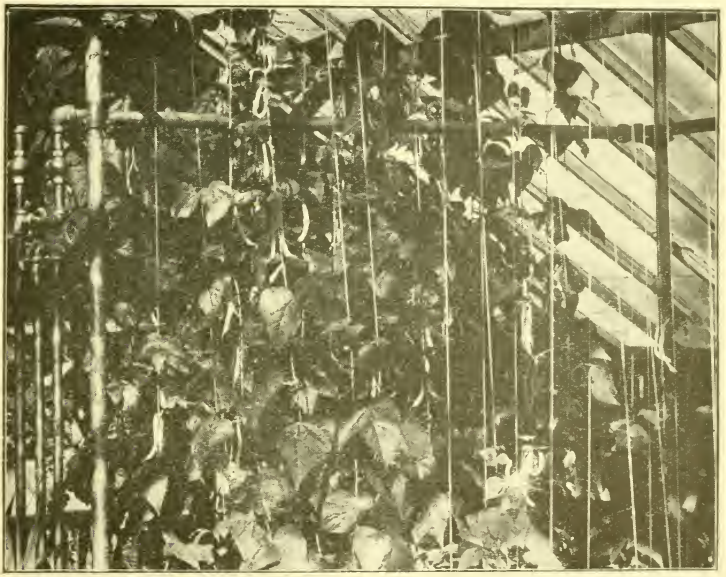


FIG. 9.—Pole beans running upon string trellis.

variety for forcing. It was early and yielded well for an average number of pickings, but later was affected with rot. The vines also did not last as long as numbers 3 and 17.

17. Early Golden Cluster (Gregory). This is a very long, waxy white bean. Vines healthy and vigorous; it was second in productiveness. Like No. 3 it continued in bearing throughout an equally long period and remained very healthy.

Seibert's Early Pole Lima Bean was also forced at the same time, and although it proved very productive and was easily

forced, it required 102 days to mature from time of germination. The fruit ripened all at once and the yield averaged 1 lb., 13 oz., per hill.

In order to compare these with various dwarf or bush beans from point of yield, the following varieties were grown under similar conditions,—Stringless Green Pod, Early Red Valentine, Marvel of Paris, Dwarf Lyonnaice, Extra Early Refugee and Improved Red Valentine,—all green pod varieties;—with Davis Kidney, Horticultural Wax, and Golden Wax of the wax varieties. The results have been tabulated in order that ready comparisons may be made. The number of plants considered in each instance is one hundred. The number of days given in the table is from time of germination until fruiting. The fruiting period has been divided into three parts in order to show in which the variety is most productive.

Number.	Variety.	No. Days Germ. to First Picking.	Weight.			Total Weight per 100 Plants.
			First Three Pickings.	Fourth and Fifth Pickings.	Sixth, Seventh, and Eighth Pickings.	
	A. Dwarf Green Pod.		oz.	oz.	oz.	oz.
1	Stringless Green Pod	55	140	170		310
3	Early Red Valentine	55	148	71		219
6	Marvel of Paris	55	148	13		161
7	Improved Red Valentine	55	140	100		240
8	Dwarf Lyonnaice	55	40	31		71
19	Extra Early Refugee	55	246	140		386
	B. Dwarf Wax.					
6	Davis Kidney	55	444	34		478
10	Horticultural Wax	55	213	57		270
11	Golden Wax	55	336	48		384
	D. Pole Lima.					
1	Seibert's Early	102	950			950
	E. Pole Beans.					
1	Lazy Wife	86	320			320
3	Mastiff Golden Pod (Apr.)	54	793	686	973	2452
3	" " " (Jan.)	57	560	208	240	1008
4	Golden Champion (Mar.)	62	197	230		427
4	" " (Jan.)	57	405	135	50	590
4	" " (Apr.)	54	590	150	150	890
17	Early Golden Cluster	54	627	387	433	1447

From the above table it is evident that the pole beans are much more productive than the dwarf varieties. Not only is this true in the first three pickings, but they continue to yield good returns for a much longer period. The time from germination to maturity is a trifle longer perhaps with pole beans than with the dwarf varieties.

It may be said, however, that the above-named dwarf varieties are not those commonly forced excepting perhaps the Extra Early Refugee; this is likewise true of the pole varieties. Doubtless should the pole bean receive attention, a variety could be developed in a comparatively short time that would be equally as well adapted for forcing as the popular Sion House variety of the dwarf beans.

Distance to Plant. The first trial was made by planting the beans in rows eighteen inches apart each way, using two or three plants in each hill. This resulted in a very dense foliage when fully grown but it did not seem to hinder their productivity.

Toward the latter part of the experiment one variety was touched with bean rot but the others were perfectly healthy. The other trial was made by planting the hills similarly but by using cords for each plant to run on instead of poles as in the former case. The plants were more evenly distributed above the bench and gave better results. Pole beans are usually planted three or four feet apart out of doors.

Catch crops, like radishes, which come off quickly, can be planted between pole beans during their earlier stages.

Insects, Fungus, and Pests. No pests of any kind seemed to trouble us excepting the single instance of pod rot which cut short the late picking of the Golden Champion variety during one of the trials. Red spider and mite are said to be troublesome in forcing dwarf beans, and these are kept in check by maintaining a moist atmosphere.

Marketing. In the East string beans are usually sold by the quart measure during season, but the forced product is generally sold by the bunch, tying up from 25 to 50 pods together, according to the size of the variety. The price varies according to the demand; it is thought that from 25 to 50 cents a bunch may be considered an average price. If dwarf beans

have been made a success, surely the best pole varieties, being more productive, cannot help from becoming a profitable crop under similar conditions.

SUMMARY.

1. Pole beans should be included in the list of vegetables adapted for forcing under glass.

2. The requisites for forcing pole beans under glass are practically the same as for bush beans, sweet corn, melons, cucumbers, etc.; a night temperature of not less than 60° with 10° or more higher during the day. The house should be kept moist, and the soil likewise should never become very dry.

3. The house adapted for forcing pole beans should have considerable space above the beds, ranging about eight feet.

4. Pole beans thrive well in almost any good fertile greenhouse soil. In this respect they resemble corn.

5. The time from germination until maturity varies with different varieties. The range for those tested was from 54 to 62 days.

6. Much time is saved by starting the seed in pots, precaution being taken not to allow the plant to become pot bound before transplanting. The plants should be in their permanent positions before they begin to run.

7. The varieties that were found to do well when tested were Mastiff Golden Pod, Early Golden Cluster and Golden Champion, named in order of productiveness.

8. A cord trellis is preferable to the ordinary bean pole for training up the plants. They are more evenly distributed by the use of the cord and, too, the shade from the pole is avoided.

9. Practically no trouble from insects or fungus attended the growing of this crop. One variety developed a slight tendency to pod rot at the last picking. Red spider and mite, which have been reported as troublesome in forcing dwarf beans, are kept in check by maintaining a moist atmosphere.

10. Where bush beans can be made a success as a main crop, with a house adapted for them, pole beans we believe, will be found much more productive, area for area, and hence more profitable.

Bulletin 63 March, 1899

NEW HAMPSHIRE COLLEGE

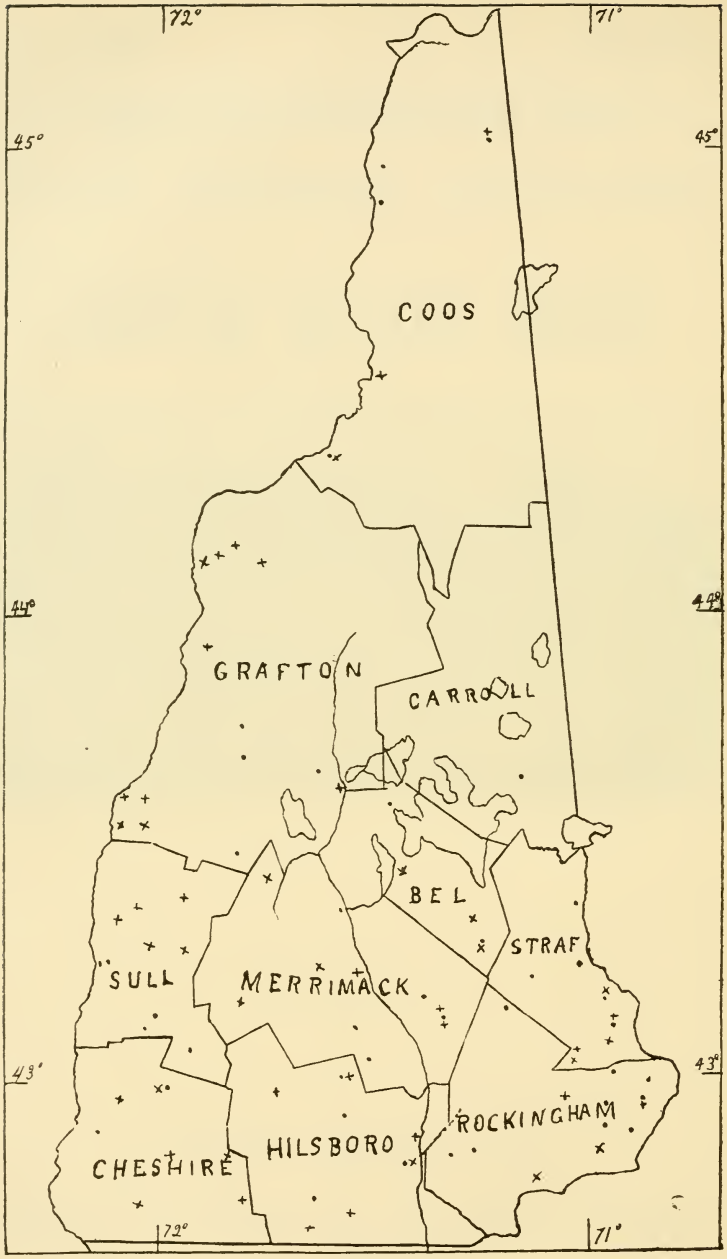
AGRICULTURAL EXPERIMENT STATION

THIRD POTATO REPORT

Experiment Station Potato Field.

BY F. WM. RANE

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS
DURHAM



Map showing points in the state where Potato experiments are being conducted.

THIRD POTATO REPORT

BY FRANK WM. RANE

The potato is an important crop in New Hampshire and in the interest of potato-growers this bulletin is issued. For the past three years a long list of varieties has been grown here at the college, the first two years having been reported upon in Bulletin 41, "Potatoes," and Bulletin 48, "Ninth Annual Report." The present report, therefore, covers the results with those varieties used in the two previous seasons together with the new introductions, and as well the results of various potato growers throughout the state, who have coöperated with the Experiment Station.

It will be remembered that when Bulletin 41 was published, we made the following offer:

"After we have selected a sufficient quantity for seed purposes, we shall be pleased to send, at the expense of the receiver, a limited quantity (a few potatoes) for test purposes, provided the person receiving them has had experience in potato growing, and will report his results as soon as the crop is harvested."

In response a very long list of applications was received from all sections of the state. They were complied with as far as the seed went and we were able to send in this way to over two hundred persons. The season of '97 proved to be wet and unfavorable and as a result comparatively few growers reported. Last spring we desired to repeat the work, and in order to ensure a reply, only those who had taken sufficient interest to respond the previous year, were included in the list. While the season was not an ideal one for potato-growing, it was not nearly so discouraging as that of the previous year. The rot was especially troublesome. In most sections a fair yield was secured, but in Coös county, a grand potato section, the crop was far below the usual yield.

The three years of experience with potato-growing here at the college, together with the reports from others throughout the state, warrant us in feeling that the data herein given represent and stand for the conditions of our state.

Following the results at the Experiment Station come the reports from the farmers, which for convenience in comparison, have been separated into counties. In comparing the various counties it will be readily seen that some are far ahead of others as potato sections; also even in the same county some seem to be able to grow good crops, while the average yield may be low. It is also evident that the returns per acre are greater in the northern than in the southern part of the state. Why is this? Some will say that their natural conditions are better; but the question might be raised, Why do a few in the southern part get equally good results? These are questions worthy of thought. The northern part of the state is farther from markets and the fact that it is necessary to raise more potatoes in order to get equal returns from area planted, may be one reason. A higher degree of cultivation and better systems of rotation are also thought to exist in general farming in the northern part of the state.

POTATOES IN COÖS COUNTY

The writer was greatly surprised to see the wonderful potato industry in Coös county, especially about Colebrook. It is not uncommon to see processions of wagons heavily laden with the finest of potatoes on their way to market throughout the potato season. A very enthusiastic young farmer, who is also a graduate from the agricultural course of the college, Mr. Burton A. Corbett, B. S., located at Colebrook, was asked to write a short sketch of potato growing, as practised in his section, which we believe will be of interest. It is as follows:

"In potato production Coös county is to this state what Aroostook county is to the state of Maine. From the very first potatoes have been one of the leading crops. Formerly nearly the whole crop was worked up into starch, there having been six starch factories in the town of Colebrook alone. At present nearly all the marketable potatoes are sold to local dealers, who ship them, for the most part, to the larger towns and cities of southern New England. The starch factories get but very few except the culls.

FIG. 11. Red American Wonder.

"In this section the potato is generally planted on sod land that was broken during the fall or summer of the previous season and given a liberal dressing of stable manure. By some the manure is turned under, and by others it is applied on the furrows and harrowed in. Both methods have stanch advocates.

"Hill culture is used altogether. The rows are placed from two and one-half to three feet apart, with the hills from twelve to twenty inches apart in the row. From ten to twenty bushels of seed are used per acre,—fifteen or eighteen bushels being the quantity used by most growers. Most of the farmers use commercial fertilizers, at the rate of from three to four hundred pounds per acre in the hill. This is thought to be profitable, as it gives the plants a good start. Both the seed and the phosphate are dropped by hand, and then covered with a two-horse hoe, with the wings adjusted for that purpose.

"Soon after the plants appear above ground they are hoed, the earth being thrown up around them with the horse hoe, which is followed by the hand hoe, to uncover any that chance to be covered and to cut or pull out stray weeds. About two weeks later the second and last hoeing is given. This time the drills are made as large as possible with the horse hoe. At this hoeing but little hand-work is done unless the piece is very tough or weedy.

FIG. 12. Carman No. 1 (10).

"After this nothing is usually done, except to apply Paris green once or twice in case the beetles threaten to injure the vines. A very few farmers use Bordeaux mixture for the blight. Some of the more painstaking pull or cut out any weeds that may appear among the vines in August, before their seeds ripen.

"The crop is dug by hand, the tined digger being the favorite implement. The average yield is about two hundred and fifty bushels per acre in good seasons. In extra good seasons entire fields sometimes yield as high as four hundred bushels per acre, and five hundred bushels are occasionally grown.

"The past season was a rather poor one for the potato-grower, as the yield was small and many varieties rotted badly. The Adirondack, which gave excellent results in 1897 and was consequently largely planted in 1898, rotted very badly and the yield was not large. The average yield of all varieties in this section was probably not more than one hundred and fifty, or, at most, two hundred bushels per acre. The varieties giving best satisfaction the past season were: Dakota Red, American Wonder (red), and Delaware or Green Mountain."

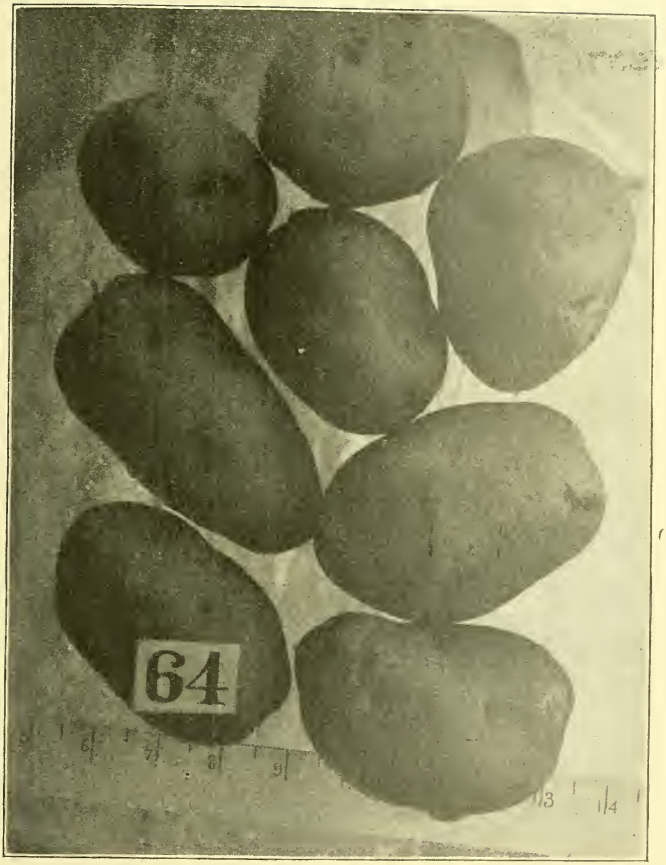


FIG. 13. Seneca Beauty.

TABLE I.—Comparison of Varieties of Potatoes, Season of 1898. (Yield Per Acre Calculated from Thirty-two Feet of Row. All Under Similar Conditions.)

Number.	Variety.	Form of Top.	Yield.			Color of skin. W, white; R, red; Y, yellow.	Per ct. of rot.
			Large.	Small.	Per acre.		
			Lbs.	Lbs.	Bush.		
1	Uncle Sam	Medium..	28½	4½	265.1	W.	1
2	American Wonder	Large	33½	8	334.4	"	4
3	Banner	Small.....	20	2½	182.4	"	2
4	Blush	Large	37¾	4½	340.6	"	
5	Brownell's Winner	Medium..	28¾	5	273.2	"	
6	Burpee's Extra Early	" ..	27½	5¼	265.1	R.	1
7	Burpee's Superior	Large	18	3¾	176	W.	
8	Bill Nye	Medium..	23¾	6½	245.2	Y.	1
9	Bracy's Rising Sun	Large	22¾	7	240.8	R.	1
10	Carman No. 1	" ..	32¼	4	293.9	W.	1
11	Carman No. 3	Medium..	30	3	267.5	W.	1
12	Champion	Small.....	16	5	170.2	Y.	1
13	Clark's No. 1	Very l'ge	35	6	332.4	"	1
14	Clay Rose	"	24½	3¾	229	R.	
15	Crown Jewell	Large	17½	9½	218.9	W.	1
16	Country Gentleman	"	27	8	283.7	"	1
17	Delaware	Small.....	27	3	243.2	"	
18	Dew-drop Rose	Large	39	7	372.9	R.	1
19	Early Harvest	Medium..	25	11¼	293.9	Y.	
20	Early Market	"	21¼	4¾	210 8	R.	
21	Early Norther	Very l'ge	27½	5¼	265.1	W.	
22	Early Puritan	Large	17¾	11	232.7	"	1
23	Early Rose	"	25	9¼	277.7	R.	1
24	Early Six Weeks	"	33½	7½	332.4	"	1
25	Everitt	"	29½	9	312.1	"	1
26	Early Fortune	Very l'ge	22	10	259.4	W.	1
27	Early Wisconsin	Large	26	5	251.3	R.	1
28	Early Thoroughbred	"	23¼	6¼	240.9	"	1
29	Freeman	Medium..	16¼	10	212.8	W.	1
30	Farmer's Alliance	Large	34½	5½	322.3	R.	1
31	Good News	.....	.....	.....	.....	W.	
32	Great Divide	Small.....	7½	1½	73	"	1
33	Green Mountain	Large	14½	3	141.9	Y.	1
34	Harbinger	"	25	8½	269.5	R.	1
35	Houlton Rose	"	30½	3½	275.6	.....	1
36	Harvest Queen	Medium..	43¾	3¼	381	W.	1
37	Howe's Premium	Small.....	21	5¾	216.5	R.	1
38	Honeoye Rose	Medium..	25¼	1½	216.5	"	1
39	Irish Cobbler	"	13	6¾	159.8	W.	1
40	Irish Daisy	Very l'ge	15	3	145.9	"	1
41	King of the Roses	Medium..	22¼	7¼	239.1	R.	
42	Koshkonong	Small.....	8	1½	77	W.	1
43	Late Puritan	Large	43½	4	385.1	"	1
44	Leonard's Favorite	Small.....	20½	2¼	184.1	R.	1
45	Maggie Murphy	Medium..	23¼	5	229	"	1
46	Money Maker	"	13½	5¼	151.7	W.	1
47	Mill's Endurance	Very l'ge	18	1	154	"	1
48	New Queen	Large	24	4½	231	"	1
49	Ohio, Jr	Medium..	21	5¼	211	R.	1
50	Orphan	Large	42	2½	368.9	W.	1
51	Parker's Market	Very l'ge	32¼	4	294.2	R.	1
52	Polaris	Medium..	25¼	7	259.4	W.	1
53	Peerless, Jr	Large	25	4	235.1	"	1
54	Prize Taker	Very l'ge	18	4	178.3	R.	1
55	Pride of Ireland	Medium..	15¾	4¾	166.2	W.	1
56	Queen of the Valley..	"	14½	4¼	151.7	"	1

TABLE I.—Comparison of Varieties of Potatoes.—*Continued.*

Number.	Variety.	Form of top.	Yield.			Color of skin. W, white; R, red; M, mixed.	Per ct. of rot.
			Large.	Small.	Per acre.		
			Lbs.	Lbs.	Bush.		
57	Quick Crop	Large	35½	5½	240.7	R.	1
58	Reeve's Rose	Very l'ge	37	6	348.6	"	1
59	Rochester Rose	Medium	13	2½	125.7	"	1
60	Rupert's Perfection	Large	19	5¾	200.3	W.	
61	Rutland Rose	Very l'ge	26	3½	239.2	R.	1
62	Rural New Yorker No. 2	Large	27½	1	231	W.	1
63	Rose No. 9	Medium	35½	.....	287.8	R.	1
64	Seneca Beauty	Large	44	2½	378	"	1
65	Sir William	Very l'ge	36	4½	328.3	W.	2
66	Somerset	Large	28½	2½	330.4	R.	1
67	Salzer's World's Fair	Medium	21½	10½	275.5	W.	1
68	Victor Rose	Large	13	8½	174.3	R.	1
69	Vick's Perfection	"	20	4½	198.6	W.	
70	Vaughan	Medium	44½	7½	419.1	R.	1
71	Vick's Advancer	Very l'ge	31½	5½	302	W.	1
72	White Star	Large	24½	4	229	"	1
73	White Mountain	"	12½	5	141.9	"	1
74	White Rose	Medium	22	3½	206.7	"	1
75	Wilson's First Choice	Large	38½	4½	346.2	"	1
76	Woodhull's Seedling	Very l'ge	32½	4½	303.9	"	1
77	World's Fair	Large	20	6½	213	"	1
78	Woodbury White	Medium	17	8	202.7	"	1
79	White Ohio	Large	13	6	154	"	1
80	Governor Rush	"	22	5	218.9	R.	1
81	Sir Walter Raleigh	"	38¾	1	322	W.	1
82	Bovee	Medium	22	6	227	"	1
83	Pink Eye	"	18½	6	198.6	R.	1
84	Livingstone	Large	31	2	267 5	"	1
85	Early Roberts	"	18	1¾	159.8	W.	1
86	Fillbasket	"	40½	2½	346.2	"	1
87	Breck's Chance	Medium	38½	4½	348.6	R.	1
88	Prolific Rose	Very l'ge	35½	6	347.2	"	1
89	Pride of the South	Medium	20	3	202.7	W.	1
90	Early Michigan	"	25	6	243.2	"	1
91	Algoma	Large	25½	3	229	"	1
92	Alexander Perfection	Very l'ge	16	6	174.4	"	1
93	Burrns's No. 1	Large	29½	4	271.6	"	1
94	Snow Flake	Medium	7	7½	117.5	"	1
95	Virgirosa	Large	31½	3½	279.7	R.	1
96	King of the Earliest	Medium	18½	6½	202.7	"	1
97	North Pole	"	28½	3¾	263.2	"	1
98	Mill's Prize	Large	24½	3	220.9	W.	1
99	Red American Wonder	"	44½	1½	368.9	R.	1
100	New Main Crop	Medium	16½	.....	133.8	"	1
101	White Beauty	Very l'ge	46	3	397.2	W.	1
102	Enormous	Medium	33	2	283.7	"	1
103	Early Dawn (13½ ft.)	"	12¾	1	250.5	R.	1
104	Early Andes (2 hills)	"	.....	.....	272.3	"	1
105	Granite State	"	11¾	5	135.4	W.	1

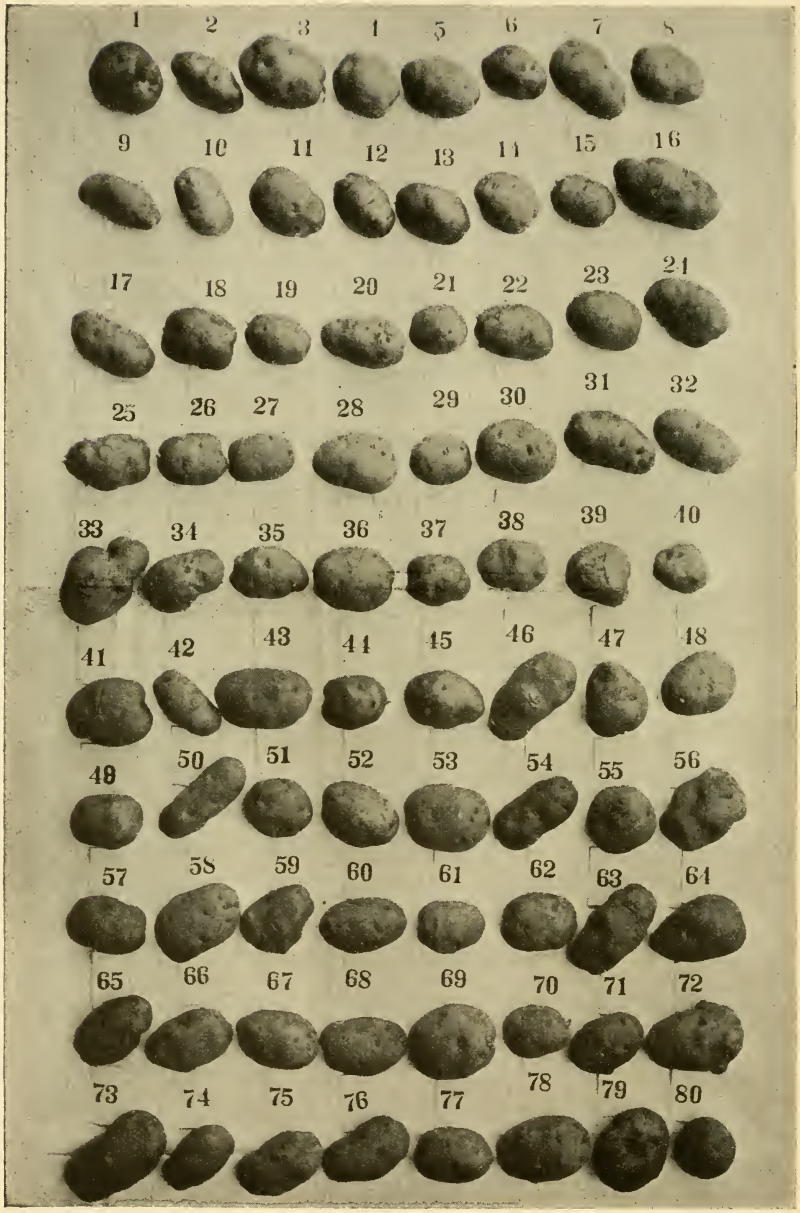


FIG. 14. Varieties of Potatoes.

TABLE II.—The Average Comparative Yield of Varieties of Potatoes for the Last Two Potato Seasons, 1896 and 1898. Grown at the Experiment Station.

Number.	Variety.	Yield per acre.	Number.	Variety.	Yield per acre.
1	Uncle Sam	240	50	Orphan	305
2	American Wonder	287	51	Parker's Market	275
3	Banner	228	52	Polaris	251
4	Blush	288	53	Peerless, Jr.	227
5	Brownell's Winner	289	54	Prize Taker	226
6	Burpee's Extra Early	240	55	Pride of Ireland	202
7	Burpee's Superior	193	56	Queen of the Valley	234
8	Bill Nye	220	57	Quick Crop	292
9	Bracy's Rising Sun	223	58	Reeve's Rose	400
10	Carman No. 1	262	59	Rochester Rose	194
11	Carman No 3	253	60	Rupert's Pecfection	252
12	Champion	161	61	Rutland Rose	224
13	Clark's No. 1	263	62	Rural New Yorker No. 2	239
14	Clay Rose	236	63	Rose No. 9	219
15	Crown Jewell	221	64	Seneca Beauty	339
16	Country Gentleman	277	65	Sir William	341
17	Delaware	229	66	Somerset	279
18	Dew-drop Rose	316	67	Salzer's World's Fair	259
19	Early Harvest	271	68	Victor Rose	223
20	Early Market	155	69	Vick's Perfection	296
21	Early Norther	255	70	Vaughan	372
22	Early Puritan	216	71	Vick's Advancer	237
23	Early Rose	272	72	White Star	268
24	Early Six Weeks	221	73	White Mountain	233
25	Everitt	236	74	White Rose	303
26	Early Fortune	204	75	Wilson's First Choice	302
27	Early Wisconsin	242	76	Woodhull's Seedling	317
28	Early Thoroughbred	231	77	World's Fair	199
29	Freeman	194	78	Woodbury White	288
30	Farmer's Alliance	284	79	White Ohio	193
31	Good News	149	80	Governor Rush	297
32	Great Divide	199	81	Sir Walter Raleigh	290
33	Green Mountain	161	82	Bovee	215
34	Harbinger	212	83	Pink Eye	160
35	Houlton Rose	290	84	Livingstone	198
36	Harvest Queen	334	85	Early Roberts	187
37	Howe's Premium	178	86	Fillbasket	320
38	Honeoye Rose	220	87	Breck's Chance	306
39	Irish Cobbler	231	88	Prolific Rose	306
40	Irish Daisy	150	89	Pride of the South	283
41	King of the Roses	274	90	Early Michigan	221
42	Koshkonong	152	91	Algoma	266
43	Late Puritan	351	92	Alexander Perfection	239
44	Leonard's Favorite	246	93	Burrns's No. 1	283
45	Maggie Murphy	215	94	Snow Flake	77
46	Money Maker	187	95	Virgirosa	294
47	Mill's Endurance	136	96	King of the Earliest	192
48	New Queen	260	97	North Pole	191
49	Ohio, Jr.	234	98	Mill's Prize	187

TESTS OF VARIETIES IN 1898

For a description of the varieties numbering from 1 to 80 inclusive, the reader is referred to Bulletin 41. For the yield of all varieties grown in 1897, see Bulletin No. 48, Ninth Annual Report. As no descriptions of varieties above No. 80 have been given, they appear in this report beginning on the opposite page.

The accompanying map (page 38) indicates where potato experiments are being conducted; the photographs also indicate the characteristics of each variety.

Our potato plot the past season was a good medium loam soil in a fair degree of fertility. A good sod, which had been previously manured with barnyard manure, was turned under and put in a proper degree of tilth; marked out in rows three feet apart and planted in the usual way, using a fair application of potato phosphate in the hill. At the second hoeing the rows were hilled. After the bugs appeared, the vines were treated twice with Paris green, and twice sprayed with Bordeaux mixture, in combination.

TABLE III.—THE SEVENTEEN VARIETIES GIVING THE LARGEST AVERAGE YIELD, IN ORDER OF PRODUCTIVENESS.

Number.	Variety.	Yield per acre.	Bushels salable.	Remarks.
58	Reeve's Rose	400	333⅓	Usually more small.
101	White Beauty (1st year)	397	371	See photograph (long).
70	Vaughan	372	310	Oblong, desirable.
99	Red American Wonder (1st year)	368	359	Excellent. See photo.
43	Late Puritan	351	319	Good cropper.
65	Sir William	341	292	Wants clay loam.
64	Seneca Beauty	339	322	Fine pink variety.
36	Harvest Queen	334	306	Desirable potato.
81	Sir Walter Raleigh	322	314	Very choice.
86	Fillbasket	320	301	Good cropper. Photo.
76	Woodhull's Seedling	317	264	Fair cropper.
18	Dew-drop Rose	316	253	Fine Rose type.
87	Breck's Chance (1st year)	306	272	Large red. Photo.
88	Prolific Rose (1st year)	306	255	Medium oval. Photo.
50	Orphan	305	289	Long potato, fine.
74	White Rose	303	253	Fair cropper.
75	Wilson's First Choice	302	269	Fair cropper.

Besides the above, the only varieties to remain in our test are Nos. 1, 2, 4, 10, 11, 16, 17, 24, 34, 38, 40, 44, 45, 47, 52, 53, 57, 61, 62, 66, 71, 80, 93, 95, 102.

FIG. 15. Sir William Potato (65).

NOTES ON VARIETIES

81. Sir Walter Raleigh (Peter Henderson & Co., New York). This variety is a seedling of the Rural New Yorker No. 2, and another of Mr. Carman's productions. The introducers claim that it closely resembles the Rural New Yorker No. 2, but is more uniform, and yields practically no small tubers; also that it is of better quality and a few days later. The above claims are true of the behavior of the variety here at the Station during the past two seasons. It made strong, heavy vines, and continued to grow late and gave a very fair yield. The tubers were practically all marketable.

82. Bovee (Henderson). A new extra early variety, first grown here in 1897. From the reports, this new variety has been quite generally liked. The vines are dwarf and stocky, dark green in color, and the stem is roundish. The flower is purple. Shape of tuber, elongated, tapering at both ends. I

yielded 227 bushels per acre during the past season, 25 per cent. of which were small.

84. Livingston (Livingston & Sons, Columbus, O.). This variety is claimed by the introducers to resemble the Seneca Beauty in general form, differing only in color. It is a strong grower, yielding the past season at the rate of 267½ bushels per acre. Most all of the tubers were of marketable size, nearly equaling the Sir Walter Raleigh in this respect.

85. Early Roberts (James J. Gregory & Sons, Marblehead, Mass.). Said to be a sport from the New Queen, which it resembles, excepting in color,—the Roberts is white. The advantage it has over the parent stock is earliness, being at least a week earlier. We have grown it now two years, with fair results. For some reason, we got better results in 1897 than the past season. It is quite favorably reported upon throughout the state. It is a strong grower, has heavy dark green foliage, and has few small potatoes.

86. Fillbasket (Gregory). This is a white-skinned, main-crop variety, oblong in form, somewhat flattened, and usually smooth and fair. It is a heavy yielder here at the Station, producing at the rate of 346 bushels per acre, a very small per cent. of which were small. The vines were strong, erect, and vigorous.

87. Breck's Chance (Joseph Breck & Sons, Boston). An early red variety. Vines medium; very erect and regular in appearance. Yield very good,—349 bushels per acre, of which 10 per cent. were small.

88. Prolific Rose (Gregory). A new seedling of the Rose type. The vines were very large and spreading. Yield during the past season, 347 bushels per acre, 16⅔ per cent. of which were small.

89. Pride of the South (Johnson & Stokes, Philadelphia, Pa.). Claimed to be a white sport of the Bliss Triumph. Vines of medium size. Yield the past season, 203 bushels per acre, with but few small pototoes. Was very susceptible to blight.

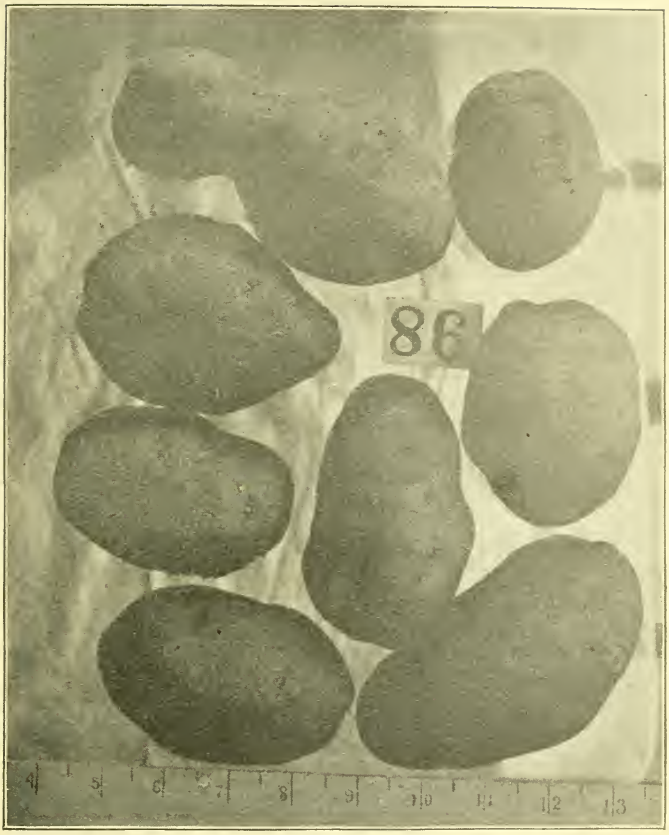


FIG. 16. Fillbasket.

90. Early Michigan (H. N. Hammond, Decatur, Mich.). This is an early potato, claimed by the introducers to be one week earlier than the Early Ohio, and also gives a better yield. We have grown it for the past two years. It is a fair cropper, producing 243 bushels per acre, about 20 per cent. of which were small. Vines regular, strong, large leaf, and medium in size. Color of skin white.

91. Algoma (Hammond). An early white potato of the Hebron class. In the wet season of '97 it produced 303 bush-

els per acre, while the past season it yielded only 229 bushels. About 10 per cent. were small.

92. Alexander Perfection. This variety was donated the Station by Mr. Jonathan M. Taylor of Sanbornton, who had them on exhibition at the State Grange Fair in 1896. This is a fine oblong potato, and yielded at the rate of 303 bushels per acre in 1897, but did not do as well the past season. The vines were very large and regular. The small potatoes composed about one third of the crop.

93. Burrns's No. 1 (Hammond). An early white potato, oblong in shape, inclined to a russet color, and with comparatively few shallow eyes. Vines large, strong, erect, and very even; about 12½ per cent. small. Average yield for two years, 283 bushels.

95. Virgirosa (Hammond). This variety was introduced by L. L. Olds of Wisconsin. It is an early white variety, oblong in shape, and quite regular. Vines about 1½ feet high and very spreading, but healthy. About 10 per cent. small potatoes. Average yield for two years, 294 bushels.

96. King of the Earlies (Hammond). A seedling of the Early Ohio, which it resembles very much.

99. Red American Wonder (Gardener & Co.). This potato is quite commonly grown in the northern part of the state, and is considered a very fine variety. When Bulletin 41 was published, Mr. W. A. Gardener of Tilton wrote me that the potato of this variety known in the northern part of the state was a red potato, and not a white, as therein described. After some correspondence in regard to identification of the potato and after raising it here at the Station, I concluded to call it the Red American Wonder. In regard to the same, Mr. Gardener writes as follows: "I find the potatoes sent you were introduced six or eight years ago by John Libby of Aroostook county, Me., into Coös county, as American Wonder. It is the most popular potato grown in that section, and is growing in favor. I have sold them for seed for four or five years. F. C. Clement of Warren, N. H., a potato dealer, told me that the American Wonder grown in Coös county gave the best satis-

faction of any potato grown in New Hampshire that he had handled this year." This was one of the heaviest yielders this year. It is a main crop variety, of good size and fine appearance. Vines dark green, very regular and erect, making a very uniform row, almost square top throughout, strong and vigorous. The crop was practically all salable. A fine variety. Yield 369 bushels per acre.

101. White Beauty (O. H. White & Son, Hall's Corners, N. Y.). This is a medium late variety, of new introduction. It belongs to the Burbank and White Star class. Vines very strong and heavy, dark green, standing 2½ feet high and 3 feet broad. Yield at rate of 397 bushels per acre, and only about 6 per cent. were small.

102. Enormous (Gregory). This variety complies very well with the introducer's claims, viz.: "Late, vines very healthy, stalks very stout and tall. Crop remarkable in quantity, potatoes very large, skin very white." The stalks at the Station were only of medium height. Yield 284 bushels per acre, with only 6 per cent. small.

103. Early Dawn (H. C. Marsh). A new red variety. Vines medium in size. Yield 251 bushels per acre, 12 per cent. of which were small.

104. Early Andes (H. C. Marsh). Resembles 103, only slightly more productive; 272 bushels per acre.

REPORTS FROM CORRESPONDENTS

As far as possible reports have been received from all sections of the state upon the results with the potatoes sent from the Experiment Station. In order to simplify matters, each county has been classified by itself and they are taken up in the following pages in alphabetical order. It so happens that Carroll county is the only one not represented.

The tables are computed to bushels per acre so that it is an easy matter to compare the yield with the same varieties in other counties or at the Experiment Station. The notes following also give the general conditions under which the crop was grown:

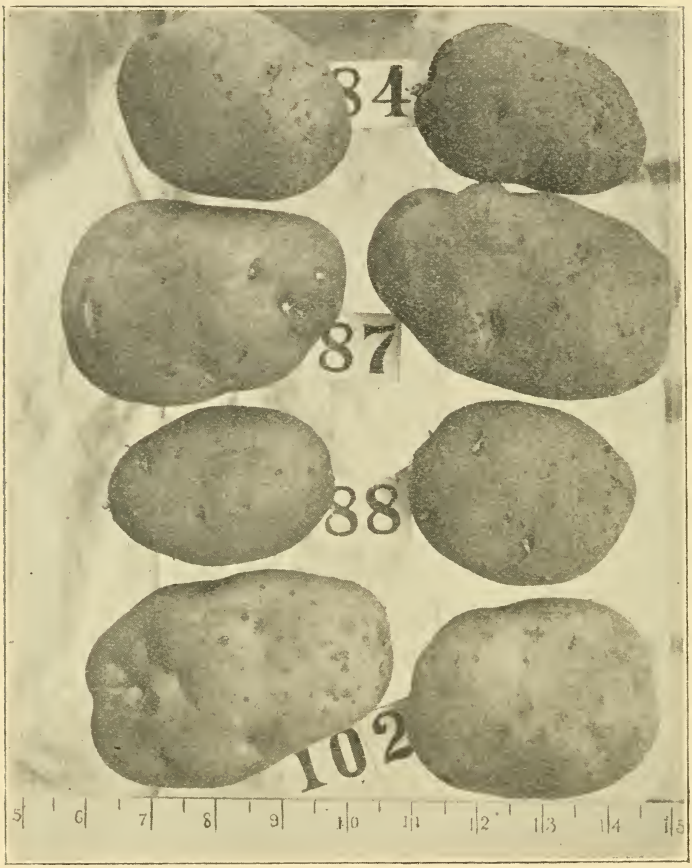


FIG. 17.

84. Livingstone.
87. Breck's Chance.
88. Prolific Rose.
102. Enormous.

BELKNAP COUNTY

NAME OF GROWER.	Soil.	Variety and Yield Per Acre of Each.									
Horace N. Colbath, Center Barnstead.	Clay loam.	No. 65	No. 3	No. 77	No. 73	No. 64	No. 68	No. 74	No. 76	No. 80	No. 75
		801.8 bu.	758.5 bu.	563.5 bu.	541.8 bu.	520 bu.	455.1 bu.	433.4 bu.	346.7 bu.	325 bu.	325 bu.
L. E. Page, Gilm'nt'n Iron Works.	Good loam.	No. 98	No. 2	No. 84	No. 97	No. 65	No. 96	No. 56	No. 79	No. 77	No. 57
		516.2 bu.	472 bu.	451.7 bu.	387 bu.	365.7 bu.	365.7 bu.	365.7 bu.	344.1 bu.	344.1 bu.	279.6 bu.

Horace N. Colbath, Center Barnstead.—"The potatoes sent me were planted in a clay loam soil, on May 20th. A light coat of cow manure was plowed in, and a handful of chemicals, mixed according to the formula recommended by the New Hampshire Experiment Station, scattered in each hill. Hoed twice. By Aug. 20th the tops of all varieties were killed by rust. I am satisfied I ought to have sprayed with Bordeaux mixture.

"Sir William (65) were smooth and large, no small ones; Banner (3) were beautiful, smooth and large; White Mountain (73), and World's Fair (77), excepting for rot were fair. Carman No. 3 (11), from another source outyielded the Sir William a little, and were all good size and no rot.

"Shall plant Carmen No. 3, Sir William, and Banner, largely next year."

L. E. Page, Gilmanton Iron Works.—"Besides the above list received from you I planted the Campbell Seedling; the tops and potatoes both look very much like American Wonder (2), and about the same yield. I planted all varieties on hard wood land which has been pastured a good many years."

F. C. Robertson, Tilton.—"The wire worms interfered with my potatoes; I therefore can not give an accurate account. The land used was new hard wood ground. A coat of dressing was plowed in and a little phosphate used in the hill. Sir Walter Raleigh (81) is a fine looking, medium-sized variety."

CHESHIRE COUNTY

Name of Grower.	Soil.	Variety and Yield Per Acre of Each.									
J. W. Fletcher, Marlow.	Light loam.	No. 65 374 bu.	No. 57 350 bu.	No. 2 331 bu.	No. 3 260 bu.	No. 11 229 bu.					
George A. Mayo, East Alstead.	Rather light upland.	No. 86 360 bu.	No. 85 313 bu.	No. 90 253 bu.	No. 93 242 bu.	No. 91 205 bu.	No. 88 201 bu.	No. 95 197 bu.	No. 3 196 bu.	No. 89 160 bu.	No. 48 136 bu.
Daniel Wilder, Surry.	Light loam.	No. 8 258.3 bu.	No. 15 234.1 bu.	No. 11 220.8 bu.	No. 16 215.5 bu.	No. 2 198.5 bu.	No. 13 196 bu.	No. 17 185 bu.	No. 10 181.5 bu.	No. 1 121 bu.	
Charles P. Jefts, Marlow.		No. 51 483.5 bu.	No. 54 338.5 bu.	No. 24 314.6 bu.	No. 7 296.8 bu.	No. 26 258.1 bu.	No. 63 258.1 bu.	No. 3 145.2 bu.			

J. W. Fletcher, Marlow.—"The potatoes sent me were given the same treatment as my other potatoes, believing it the only true test I spread about twenty loads of barnyard manure, saved under glass, to the acre, with a handful of hen manure to the hill. The soil was a light loam containing a

great many large stones and had not been plowed for a dozen years or more Hills two feet apart. There was no rot to speak of. Banner (3) and Carman No. 3 (11) were poor table potatoes, and rather small. Quick Crop (57) contained many small potatoes; Banner (3) having none. American Wonder (2) and Sir William (65) were a little inclined to be prongy. I should rate the varieties about as the yield per acre indicates. I plant for my main crop the Minister and Green Mountain,—both excellent potatoes, but no better than the Sir William (No. 65)."

Daniel Wilder, Surrey.—"The potatoes received from you were planted upon the Ashuelot river land, a sandy loam. The fertilizer used was a good coating of stable manure. The crop suffered from a dry spell which shortened the crop very much. Carman No. 3 gave the largest per cent. of marketable tubers."

George A. Mayo, East Alstead.—"Potatoes were planted on rather light upland, of medium moisture. Corn was raised on the plot the year previous, with a good coat of stable manure.

"Ground was twice plowed and thoroughly pulverized. Furrowed by running a one-horse plow each way, so as to get good depth,—drew back some of the fine dirt to bottom of furrow,—sprinkled in potato fertilizer, 600 pounds to acre, and mixed with the fine soil. Cut tubers to two eyes and planted fifteen inches apart, and four to five inches deep,—rows two and a half feet apart. Cultivated frequently and kept free from weeds. Did not treat for blight or scab and had little trouble from them.

"At time of digging, measured space occupied by each variety, weighed the potatoes and estimated yield per acre, and my notes were made at the time on that basis. Dug early in September.

"89. Pride of South. Grow compactly in hill almost none below cooking size, scabbed a little. Yield 160 bushels per acre.

"82. Bovee. Very few small, 196 bushels per acre, good quality and appearance.

"85. Early Roberts. Good size, few small. Have never seen a nicer looking lot of potatoes as they lay upon the ground after digging. Yield 313 bushels per acre.

"95. Virgirosa. Of good cooking size, compact in hill, 197 bushels per acre. Desirable.

"90. Early Michigan. Compact in hill, very few small, 253 bushels per acre. Promising.

"93. Burrns No. 1. Few small, one decayed tuber found,—the only one found in the ten varieties,—242 bushels per acre.

"88. Prolific Rose. Fine appearance, cooks about like Early Rose, 201 bushels per acre.

"86. Fillbasket. Average large, practically no small ones, near the surface and close to stock. Very promising, good quality, 360 bushels per acre.

"91. Algoma. Fine appearance, free from scab, good size, promising, 205 bushels per acre.

"92. Alexander Perfection. Merits continued trial. Looks well and quality good, 245 bushels per acre.

"Have raised a number of other varieties the past season. The Enormous is a large potato of good appearance, yield 313 bushels. Early Thoroughbred yielded well, but were not shapely as some, and hardly met expectations. Howe's Premium, 230 bushels per acre, cooks well at time of digging. Several of the older varieties I shall discard, as there are too many small ones, as the Delaware, Early Rose, Late Rose, Lee's Early Favorite, Beauty of Hebron, etc. The American Wonder yielded a little better than any other, and is quite good. The Joseph is a good yielder, and of good quality; I regard it as among the very best. New Queene gave lowest yield of any, 136 bushels per acre; it does not succeed with me. For table use the varieties sent were so uniformally good that I am not able to decide, from one year's trial, which would be the best for this locality. Shall try all another year. Did not weigh the small ones separately, for the reason that they amounted to very little in any variety. While none of the tubers was very large, nearly all were of good size for table use. This might have been owing to exceptional conditions of the season.

"I believe the first rule in potato culture should be, "Pulverize, *pulverize*, PULVERIZE the soil." With us the newer varieties seem to have more vigor and give better satisfaction."

Charles P. Jefts, Marlow.—"The potatoes received from you were planted on moist loam and dug September 8th. There was very little rot in any of them. All of the varieties reported upon I am saving for future use."

COÖS COUNTY

Name of Grower.	Soil.	Variety and Yield Per Acre of Each.									
W. H. Forbes, Groveton.	Light clay loam.	No. 95	No. 92	No. 91	No. 93	No. 86	No. 89	No. 81	No. 88	No. 85	No. 90
		832.8 bu.	771.4 bu.	756.4 bu.	726 bu.	680.6 bu.	635.3 bu.	605 bu.	574.8 bu.	529.4 bu.	452.8 bu.

W. H. Forbes, Groveton.—"The kind of soil where the varieties were planted was a light clay loam. All of the rows from which the above computations were made were sixteen feet long. All of the varieties rotted more or less, being on the average about one fifth of the total. The long severe drouth in June and July injured the crop very much; and the very hot weather the last of August and the first part of September is the cause, in my opinion, for the large amount of rot. I believe the Algoma, Alexander Perfection, and Virgirosa are the best kinds to raise in my part of the state."

E. Geo. Rogers of Colebrook, and J. C. Poore of Stewartstown, reported that potatoes were a light crop this season with them, and the rot and late frosts rendered their reports valueless.

GRAFTON COUNTY

Name of Grower.	Soil.	Variety and Yield Per Acre of Each.								
Wm. S. Gove, Lebanon.	Rich loam.	No. 88	No. 86	No. 91	No. 89	No. 90	No. 93	No. 85	No. 92	No. 82
		726 bu.	645.3 bu.	457.1 bu.	430.2 bu.	376.4 bu.	322.7 bu.	295.7 bu.	268.9 bu.	215.1 bu.
W. W. Chamberlin, Woodsville.	Sandy loam.	No. 68	No. 64	No. 65	No. 76	No. 75	No. 77	No. 74	No. 80	No. 73	No. 81
		568.7 bu.	445.5 bu.	403.3 bu.	403.3 bu.	402.4 bu.	332.7 bu.	330 bu.	315.2 bu.	313.5 bu.	267.3 bu.
Albert Pinneo, Hanover.	Medium loam.	No. 51	No. 41	No. 54	No. 33	No. 57	No. 43	No. 60	No. 63	No. 31	No. 62
		572 bu.	539 bu.	520.4 bu.	506 bu.	473 bu.	457 bu.	440 bu.	429 bu.	374 bu.	297 bu.
Geo. N. Burnham, No. Dorchester.	Rich sandy loam.	No. 65	No. 64	No. 81	No. 80	No. 73	No. 76	No. 58	No. 74	No. 75	No. 77
		399.3 bu.	322.7 bu.	291 bu.	258.1 bu.	240 bu.	237.9 bu.	198.3 bu.	198.3 bu.	198.3 bu.	198.3 bu.
Arthur Wood, Bath.	Rich loam.	No. 68	No. 74	No. 80	No. 75	No. 11	No. 67	No. 65	No. 81	No. 73	No. 77
		375.1 bu.	326.7 bu.	326.7 bu.	314.6 bu.	304.2 bu.	278.3 bu.	255.8 bu.	242 bu.	242 bu.	229.9 bu.
Geo. W. Atwood, Ashland.	Int'rvale sandy loam.	No. 97	No. 84	No. 77	No. 79	No. 61	No. 98	No. 96			
		349.5 bu.	242 bu.	242 bu.	166.4 bu.	145.2 bu.	107.5 bu.	100.8 bu.			
C. P. Olin, Lyman.	Black loam.	No. 90	No. 86	No. 81	No. 93	No. 82	No. 57	No. 28	No. 91	No. 2	No. 89
		302.9 bu.	233.3 bu.	228.3 bu.	228 bu.	207.4 bu.	201.6 bu.	201.6 bu.	189.1 bu.	176 bu.	175.4 bu.
J. W. Blair, Woodsville.	Light sandy loam.	No. 80	No. 92	No. 96	No. 26	No. 16	No. 66				
		272.3 bu.	243.1 bu.	223.7 bu.	210.4 bu.	187 bu.	138.3 bu.				
Elmar Moulton, Haverhill.	Old pasture.	No. 86	No. 88	No. 93	No. 85	No. 22	No. 89	No. 90	No. 19	No. 26	
		231.9 bu.	228.5 bu.	228.5 bu.	221.8 bu.	207.4 bu.	191.6 bu.	184.4 bu.	184.2 bu.	152.4 bu.	

FIG. 18. White Beauty.

W. W. Chamberlain, Woodsville.—"My potatoes raised from the seed sent me by you are a fine lot, perfectly free from rot, and not enough scab present to take any account of. All varieties were planted on May 6th, and dug on August 27th. The soil was a sandy loam. The fertilizer used was to spread on manure in the fall, which was plowed in in the spring; then 1,200 pounds of Buffalo potato phosphate was applied in drills.

"Sir William (65) and Governor Rusk (80) had a few prongs on them, while the others were very smooth, and all of them would please any man. Seneca Beauty (64), Victor Rose (68) and World's Fair (77) are my choice from yield and looks. Sir Walter Raleigh (81) are very large but handsome.

W. G. Gove, Lebanon.—"The soil in which the varieties were planted was greensward and of a rich loam, plowed eight inches deep and harrowed twice over with a spring-tooth harrow. Many of the varieties did fairly well, but I am inclined to think they will do better next season. From a piece of

land ten rods square I had one hundred and sixty bushels of nearly all salable potatoes."

H. H. Harris, Etna.—"I enclose report on potatoes received from you. I regret to say I overlooked the measuring of the rows. They were grown on a light loam; were sprayed three times with Bordeaux mixture; were all entirely free from rot. No. 2 seems to lead all the rest, being very handsome and great yielders. Nos. 1 and 10, large and handsome; 11 and 16, clean and fine looking; 3, 5, and 17, inclined to be scabby, the last named very much so with many small ones."

Elmore Moulton, Haverhill.—"I now report result of potato planting this season. You sent me fourteen varieties, of which I gave four to a friend and planted ten myself. The land was a plat previously pastured,—plowed last fall, fertilized with stable manure, and, in addition, a handful of phosphate in each hill at time of planting. I planted the entire plat to potatoes. A dry spell in the early season had a bad effect upon the yield, but the quality in all varieties proved very good. They were planted May 13, cut in three or four pieces, one piece in a hill. The result is as shown in table.

"Pride of the South (89) was the earliest by two weeks. Burrns's No 1 (93) and Early Roberts (85) were large, handsome, and even in size. Algoma (91) is a very attractive potato. Early Fortune (26) was very scabby and ill. shaped. Fillbasket (86) was later than the others, but seems desirable. I may add, that for my main crop I raised Maggie Murphy (45) an excellent potato and very productive; Green Mountain (33), a white, handsome, very desirable variety; Tyler, the best "next summer" kind I know of; Polaris (52), which I shall never plant again, and the old reliable Pearl of Savoy."

A. Pinneo, Hanover.—"The potatoes received from the Experiment Station were planted May 7th and dug the latter part of September. Hills eighteen inches apart. Soil, medium loam. Applied about ten cords of cow manure per acre, on surface. Phosphate one side of the hill, three hundred pounds per acre. Hen manure, a handful. Ashes at first hoeing."

A. M. Poor, Landaff.—"I was not present when the potatoes sent me were dug; each variety was kept separate, however. The Country Gentleman and Sir William yielded about the same. Carman No. 3 tubers were larger and more even in size than any other variety. The Reeve's Rose were more in number than any other variety, and were near the yield of the Country Gentleman, and on some soils would yield a larger crop. They were all free from blight, but we were badly troubled by bugs this season. They were raised on hard-wood and pine land. Land broken up in the spring, manure plowed under. Phosphate used in the hill. I think they all would average about three hundred bushels per acre. The rust struck here early in the season, and so the potatoes were dug the first week in September.

"The four varieties of potatoes sent me last year were planted again this season where corn was raised last year, using no manure this year. They were all of good quality and no rot. American Wonder (2) was the finer looking, but Sir William yielded the most. There were but few small ones."

Arthur Woods, Bath.—"The varieties received this year were all planted in old strawberry bed loam, which resulted in all of them being more or less scabby. They were dug September 1st, and were free from rot. Victor Rose (68) were the earliest. Governor Rusk (80) were very uneven, varying from very small to one pound in size."

George W. Burnham, North Dorchester.—"The potatoes were planted the 25th of May, on sandy loam, towards the south and east. Last year the land had a light coat of stable manure, and raised beans. This year a good dressing of stable manure was applied, and the seed cut one eye to the piece and two pieces in hill, with phosphate in hill. But each year has its drawback. We had a severe drouth of five weeks, not one drop of rain, and seven without enough to wet down the hills; so the yield was smaller than it would otherwise have been. Although the potatoes were fair size, they did not average large. Enough set, however, to have had a large crop. Sir Walter Raleigh (81) rotted and were scabby; all other varieties equally good."

C. P. Olin, Lyman.—"The soil in which the potatoes were planted was a black loam, lying across a knoll. There was practically no rot, excepting that of the Sir William, which was about fifty per cent., and besides, very scabby. For an early potato I prefer the Early Roberts (No. 85); the vines plainly indicated that it led all the others in growth. For market, should prefer the Fill Basket (86); it grew the largest number of salable potatoes."

J. W. Blair, Woodsville.—"The potatoes sent me were planted May 11th, in a light, sandy soil. King of the Earliest (96) was ripe and dug upon Aug. 20; the remainder were dug Aug. 30th Somerset (66) and Country Gentleman (16) did not do as well as the others."

G. W. Atwood, Ashland.—"The potatoes received from the Experiment Station were planted on river intervale land, above high water; sandy loam, broken up last fall. A little manure was spread on furrows and well harrowed in this spring. Planted May 7th, in rows three feet apart, dropping the seed, which was cut to two eyes to the piece, about fifteen inches apart in the row. The rows were furrowed out about four inches deep, and 1,500 pounds of Essex Complete Potato Fertilizer was spread in the rows. A 35-pound chain, folded, was used to fill the furrows and mix the fertilizer. Covered with a spring-tooth harrow, first lengthwise, and then cross the furrows; a few were dragged out. The piece was harrowed with a spring-tooth harrow before many of them came up; a Breed weeder was run through two or three times, and a light hoeing given. About July 20th the barn grass came up, and we went through them again. Sprayed once with the Bordeaux mixture. The Carman No. 3 (11) sent me last year, were very good. My potatoes did not set well, very few in a hill, but all good size; some hills had but one or two very large potatoes. I attributed the cause to dry weather."

HILLSBOROUGH COUNTY

Name of Grower.	Soil.	Variety and Yield Per Acre of Each.									
George F. Clough, East Weare.	Light loam.	No. 43	No. 63	No. 51	No. 57	No. 41	No. 54	No. 62			
		159.6 bu.	144.7 bu.	141 bu.	140.8 bu.	132.7 bu.	100.8 bu.	75 bu.			
Pierce Bros., Hollis.	Old garden.	No. 28	No. 10	No. 2	No. 11	No. 1	No. 17	No. 16	No. 8	No. 3	No. 5
		431 bu.	352 bu.	333.3 bu.	271 bu.	280.7 bu.	176.8 bu.	162.8 bu.	159.5 bu.	143.5 bu.	129 bu.
D. G. Roberts, Goffstown.	Gravelly loam.	No. 85	No. 48	No. 57	No. 33	No. 66	No. 86	No. 58	No. 90	No. 96	No. 82
		260 bu.	260 bu.	240 bu.	224 bu.	224 bu.	224 bu.	208 bu.	208 bu.	208 bu.	240 bu.
Wm. H. Huse, Manchester.	Black loam.	No. 65	No. 2								
		242.2 bu.	120 bu.								

George F. Clough, East Weare.—"The potatoes sent me were planted on new ground of a light loam, not very dry. I spread on a good crop of stable manure and used also a compost of hen manure, half and half, but no phosphate. Think I missed it by not using the latter. I Paris greened them but once. We have not had a good crop of potatoes in this section now for two years. The varieties I liked very much; of those received this year are Late Puritan (43), Prize Taker (54), and Parker's Market (51).

"Of the varieties received last year I planted same again. Uncle Sam (1) is too late for this place, as it is very frosty here. Sir William (65), Reeve's Rose (58), and Orphan (50) did very well and I shall plant Sir William and Orphan as a main crop next year. The new varieties did as well, and in most cases better than the kinds that have been planted here right along."

Pierce Brothers, Hollis.—"Report of ten varieties of potatoes sent from Experiment Station. Planted April 19th and gathered September 16th. Planted upon an old garden, using small handfuls of phosphate in a drill. Used drill process of planting and hilled up somewhat in hoeing. Applied Paris green to destroy bugs. Bugs not as plenty in any of our fields as usual. Blight did not effect the vines which were uncommonly green and luxuriant.

"The yield, while not large, was in most varieties fair, and of excellent quality. The amount of rot in our fields was trifling. We found the experiments interesting, and take pride in our boxes of potatoes.

"The potatoes were cut to one eye and planted in drills. Some rotten ones among Nos. 16 and 11, very few scabby ones, in fact so little of it that we made no account of it. We think the Early Thoroughbred the finest potato

(*i. e.*) in yield, shape, and size, while Carman No. 3 is the handsomest. Brownell's Winner, while giving an average yield, produces fine shaped, marketable red tubers."

Wm. H. Huse, Manchester.—"Of the varieties received last year, I planted two again this season, Sir William (65) and American Wonder (2). The seed was cut one eye to the piece and planted in hills about eleven inches apart. The land was a black loam, with sandy sub-soil, and rather wet."

D. G. Roberts, Goffstown.—"I send herewith my report on potatoes for 1898. Soil, gravely loam, with a slight western incline. Previous to 1897, long in grass. Plowed in spring of 1897 and grew ensilage corn with fertilizer only. Well plowed in fall. Plowed once and harrowed six times in spring of 1898. No manure. One ton per acre of Bradley's Potato Fertilizer. Length of row, one rod. Rows to a rod in width, six. Each row occupied one sixth of a square rod. Each row seeded as near alike as possible. Furrows six inches deep and seed in bottom, then lightly covered, then fertilizer scattered along the row, and then seed covered two inches deep. Horse hoed three times and hand hoed once. Bugs kept off with Paris green and plaster. All planted April 19, 1898. No rot in any lot.

"All varieties dug after the foliage had turned yellow. The three best early, for market, were Nos. 85, 82, and 26. The three best medium, for market, were Nos. 11, 33, and 86. Nos. 89 and 91 are very promising, but this was my first trial of them. Nos. 48, 66, 90, and 93 rank high as a second early market potato."

MERRIMACK COUNTY

Name of Grower.	Soil.	Variety and Yield Per Acre of Each.									
Stillman Clark Danbury.	Old garden soil.	No. 43	No. 63	No. 54	No. 51	No. 33	No. 41	No. 62	No. 57		
		80.7 bu.	80.7 bu.	74.6 bu.	71 bu.	65.2 bu.	60.5 bu.	58 3 bu.	57.6 bu.		
J. R. Hills, Penacook.	Light sandy loam.	No. 82	No. 91	No. 92	No. 86	No. 93	No. 88	No. 95	No. 90	No. 98	No. 65
		244 bu.	230.5 bu.	217.8 bu.	216 bu.	215.2 bu.	200.3 bu.	195.9 bu.	195 bu.	184.2 bu.	148.7 bu.
F. W. Stevens, E. Pembroke.	Sandy loam.	No. 68	No. 1	No. 65	No. 81	No. 73	No. 80	No. 2	No. 75	No. 76	No. 77
		414.8 bu.	325 bu.	302.5 bu.	259.3 bu.	259.2 bu.	242.4 bu.	242 bu.	226.9 bu.	220 bu.	207.4 bu.
F. B. Sawyer, Webster.	Medium loam.	No. 2	No. 28	No. 16	No. 10	No. 8	No. 17	No. 3	No. 5	No. 11	No. 1
		456.2 bu.	456.2 bu.	369 bu.	268 bu.	233 bu.	226 bu.	177 bu.	160 bu.	152.6 bu.	150 bu.
J. M. Snyder, Webster.	Sandy loam.	No. 58	No. 98	No. 65	No. 68	No. 80	No. 3	No. 70	No. 81	No. 64	No. 74
		532.6 bu.	435.6 bu.	416.4 bu.	407.4 bu.	346.6 bu.	326.7 bu.	302.6 bu.	283.5 bu.	273.2 bu.	255 bu.
F. O. Melvin, Bradford.	Medium loam.	No. 10	No. 17	No. 8	No. 2	No. 5	No. 16	No. 3	No. 11	No.	No.
		good	good	good	good	light	light	light	light		

Stillman Clark, Danbury.—"The potatoes received from you were planted May 24th, and dug October 1st. Hills, three by three feet, and soil old garden ground. No manure was used, but 300 pounds of Bradley's Potato Fertilizer was applied to the acre. The soil was dry and rather sandy. The best yield was Late Puritan (43) and Prize Taker (54). The ground was not favorable and the rust was very troublesome. Plenty of potatoes set, but about one half did not reach salable size. I have the best results from the White Jersey potato; have planted it for seven years, and it is as productive now as it was when first planted."

John C. Mills, North Dunbarton.—"The potatoes I planted were all affected by rot, more or less. Of the varieties you sent, the Governor Rush (80) yielded almost double the others, and was large and fine-looking."

Francis B. Sawyer, Webster.—"The potatoes were planted upon hill land of medium moisture. Ordinary culture was given, and the same number of hills and amount of seed was given each kind. The Carman No. 3 was not as badly attacked by potato bugs as the others. The American Wonder (2) were nearly all marketable, likewise Carman No. 1 (10), Bill Nye (8), Banner (3), and Delaware (17). Country Gentleman (16) were about one quarter small. Carman No. 3 (11) contained many small potatoes."

J. M. Snyder, Webster.—"No. 58, Reeve's Rose, turned out the best, and were fine potatoes, but had quite a lot of small ones, and not quite as smooth as Banner (3). These were all good-sized, and a very pretty potato. No. 73 is not worth planting. Reeve's Rose (58), Banner (3), Mills' Prize (98), Sir William (65), Uncle Sam (1), and Victor Rose (68), are all good potatoes. The land I planted on was a moist, sandy soil. I under-drained it this spring; it was so wet last year I did not get hardly any potatoes. It was taken out of pasture two years ago, and manured, although not heavily."

F. W. Stevens, East Pembroke.—"I planted the varieties you sent me, upon a sandy loam, reclaimed from a pasture, which had borne three heavy crops of corn, and therefore was dressed each year with cellar manure and phosphate. This season, a good dressing of cow manure from the cellar was turned under, and 400 pounds of potato phosphate per acre was applied in the drill. The hills were fifteen to eighteen inches apart, and the seed cut to from one to three eyes to the piece. There were few in a hill, but of good size."

"The Victor Rose (68) extra large and fine, little rot, and very few small ones, on the whole, the best of all I planted. Uncle Sam (1) large and fine, no rot, no small ones. Sir William (65) good yield, large and fine. Sir Walter Raleigh (81) nearly all large and smooth, a fine potato. The others, with the exception of Wilson's First Choice (75), White Rose (74), and Governor Rush (80) were very good. These three contained many small ones."

John R. Hill, Penacook.—"The potatoes were planted on light, sandy loam. The sod was broken in the spring, and a good coating of stable manure was harrowed in. The seed was planted May 2 in rows three and one half feet, and hills eighteen inches in the row. Bovee (82) medium early, large, smooth, no small ones. Early Michigan (90), large, and all smooth, very early. Burns No. 1 (93), smooth and very handsome. Fillbasket (86) a medium late,

generally large, few small. Virgirosa (95) medium early, uniform in size, very handsome. The remainder were more or less scabby, or too small. Sir William was very poor. My main crop was New Queen (48); there were very few in a hill, but nearly all were of good size."

F. O. Melvin, Bradford.—"Planted May 18, 1898, on ground broken up in fall of 1897, with manure plowed under; well harrowed in spring, and planted in drills three feet apart, eighteen inches apart in drills, with Reed's Special Potato Manure in drills. Soil medium. Most of the varieties were smooth, with a very few prongy ones, and not much rot among them. The season was much better than last year for the growing of potatoes, but I did not have as large a yield as I usually have."

ROCKINGHAM COUNTY

Name of Grower.	Soil.	Variety and Yield Per Acre of Each.									
Thomas Barrett, Newton Junction.	Heavy.	No. 63	No. 57	No. 43	No. 33	No. 51	No. 62	No. 41	No. 60	No. 31	No. 54
		190.7 bu.	165 bu.	165 bu.	110 bu.	102.7 bu.	98.5 bu.	95.3 bu.	91.7 bu.	78.8 bu.	73.3 bu.
J. L. Currier, South Hampton.	Gravelly loam.	No. 41	No. 63	No. 60	No. 81	No. 62	No. 82	No. 31	No. 33		
		163.3 bu.	125.3 bu.	115.9 bu.	99 bu.	95.9 bu.	88.7 bu.	66 bu.	60.5 bu.		
Horace M. Hills, Plaistow.	Heavy loam.	No. 68	No. 65	No. 81	No. 77	No. 75	No. 64	No. 2	No. 43	No. 38	No. 73
		283.1 bu.	272.2 bu.	242 bu.	201.7 bu.	190.8 bu.	189 bu.	185.7 bu.	182.4 bu.	171 bu.	169.9 bu.
C. E. Smith, Exeter.		No. 92	No. 88	No. 91	No. 95	No. 83	No. 82	No. 90			
		229.3 bu.	221.2 bu.	174.5 bu.	152.1 bu.	145.2 bu.	131.5 bu.	114.3 bu.			

Thomas Barrett, Newton Junction.—"The soil in which the potatoes from the Experiment Station were planted was new ground, which was heavy and rocky. The only fertilizer used was Stockbridge's Potato Manure, at the rate of 800 pounds per acre. There was no rot in any of the varieties. The ones I prefer are Quick Crop (57), Rose No. 9 (63), Late Puritan (43), and Rural New Yorker No. 2 (62)."

J. L. Currier, South Hampton.—"The potatoes received from the Experiment Station were planted in a gravelly loam soil. The previous season, the land was cropped with corn and Hungarian, using as a fertilizer a part each of manure and fertilizer. The potatoes were planted in drills three feet apart, using one or two eyes to the piece, and dropping them about one foot apart in the row. The fertilizer was one ton of Stockbridge Potato Manure per acre, one half harrowed in, and the remainder in drill. They came up

well, and by August 1st, the vines covered the ground. The vines remained green until September 1st. They were dug on September 30. I lost, by rot about one third of the crop. Judging by looks, should prefer Sir Walter Raleigh (81), Rose No. 9 (63), and King of the Roses (41); next Bovee (82), and Uncle Sam (1)."

H. M. Hills, Plaistow.—"The potatoes received from you were planted May 24, on land broken up in 1897, and planted to potatoes. Soil was a rather heavy loam, and was furrowed out, and a fair amount of hen manure put in drill. Wood ashes were put around potatoes at the second hoeing. They were well cared for throughout the season, and dug on September 3. Found no rot. The season was unfavorable for best results. Victor Rose (68), American Wonder (2), Wilson's First Choice (75), Sir William (65), and Seneca Beauty (64) yielded the largest per cent. of good potatoes."

Charles E. Smith, Exeter.—"I enclose the results from the potatoes received from you last spring (see table). All of my varieties were bothered, more or less, with rot. The varieties I have been growing are the Late Rose, Delaware (17), and Fillabsket (86). The Delaware rotted least of all. Quick Crop (57) is a good potato, but rots too badly. Sir William (65) might do well in a better season."

STRAFFORD COUNTY

Name of Grower.	Soil.	Variety and Yield Per Acre of Each.									
H. E. Coffin, p. o., Berwick, Me.	Good loam.	No. 68	No. 80	No. 65	No. 75	No. 19	No. 76	No. 77	No. 58	No. 74	No. 64
		314.8 bu.	very h'avy	267.9 bu.	259.3 bu.	237.7 bu.	229 bu.	224.7 bu.	207.4 bu.	181 bu.	272.9 bu.
George D. McDuffee, Dover.	Rather dry loam.	No. 28	No. 16	No. 10	No. 2	No. 8	No. 57	No. 3	No. 65	No. 17	No. 11
		239 bu.	203.1 bu.	203.1 bu.	203.1 bu.	200 bu.	178.5 bu.	169.4 bu.	145.2 bu.	142.2 bu.	142.2 bu.
Eli Meader, Rochester.	Sandy loam.	No. 82	No. 85	No. 93	No. 95	No. 86					
		153.8 bu.	133.2 bu.	131.1 bu.	123 bu.	103.7 bu.					
A. E. Ross, Somersworth.	Dark sandy loam.	No. 90	No. 93	No. 87	No. 81	No. 89	No. 95	No. 80	No. 96	No. 83	No. 92
		435.6 bu.	419.5 bu.	403.2 bu.	371 bu.	354.9 bu.	338.7 bu.	322.6 bu.	322.6 bu.	306.5 bu.	290.3 bu.
J. H. Stiles, Strafford Centre.	Clay bottom.	No. 88	No. 89								
		193.6 bu.	189.6 bu.								
Lucien Thompson. Durham.	Light loam.	No. 33	No. 57	No. 31	No. 11	No. 16	No. 69	No. 28	No. 73	No. 76	No. 5
		617 bu.	484 bu.	403.3 bu.	348.5 bu.	206.6 bu.	173.4 bu.	157.5 bu.	144.4 bu.	93.3 bu.	83.3 bu.

Lucien Thompson, Durham.—"Soil light, plowed spring of 1898. Crop, in 1897, only one-half ton of June grass per acre. No manure; used 800 pounds Bradley Potato Fertilizer in furrow. Furrowed out and covered by horse power. Hoed, and Paris green used twice. Only ordinary care. Potatoes free from scab, and not more than four quarts of rotten potatoes found. Two years' trial show me that Green Mountain (33) are the best yielders, and the most profitable for a general crop. I shall continue the Green Mountain and Carman No. 3 (11) for my field crop of 1899, and plant few early kinds for my own use. The Carman No. 3 stands blight better than my other kinds, tops being the last to die."

H. E. Coffin, Berwick, Me.—"The varieties of potatoes received from you were planted in good season, as soon as the ground was warm. The soil was a mellow and rich loam on high ground, and sloping to the south. I spread on a heavy coat of stable manure, and used a handful of Swift's Lowell Fertilizer in the hill. The yield was not very large. The Victor Rose (68) were large and smooth, extra fine. Governor Rush (80) gave the largest yield, nearly all smooth and nice. All of the others were also smooth and fine excepting Reeve's Rose (58), which were one fourth small, and quite scabby. Algoma (91) small and scabby, and White Mountain (73) rather small. Early Harvest (19) was the earliest; fine, smooth, but not very large."

George D. McDuffee, Dover.—"The soil in which the potatoes were planted was a loam not ordinarily wet. The rows were twenty feet long, and twelve hills to the row. Date of planting, May 1. All varieties rotted, more or less. Early Thoroughbred (28), early and all right, Carman No. 3 (11), handsome, Uncle Sam (1), little rot, medium early, Delaware (17), many lack vitality, Sir William (65), no good. Carman No. 1 (10) scabby, Banner (3), promising, excepting the rot."

Eli Meader, Rochester.—"The soil in which the varieties were planted was a sandy loam. Only with a few exceptions, namely, Burrns's No. 1 (93) and Virgirosa (95) were free from rot. The only ones rotting quite badly were Fill Basket (86) and Alexander Perfection (92)."

A. E. Ross, Somersworth.—"The land that I planted was used for potatoes the year before, with an application of 23 per cent. of S. P. Guano. This year I used eight cords of barnyard manure, and one-half ton of Guano per acre. I planted Green Mountain (33) of my own seed, on one side, and Maggie Murphy (45) on the other side. None of the varieties were as large as my Green Mountains, and nowhere with the Maggie Murphys. I saved only Early Michigan (90) and Breck's Chance (87) for trying again. There was no scab; I dusted all my potatoes, after they were cut, with flour of sulphur, and thought it helped them. Soil a dark, sandy loam."

J. H. Stiles, Strafford Centre.—"All of the varieties sent me rotted badly; taking them as a whole, fully two thirds were lost. They were planted in a clay soil, on a side hill."

SULLIVAN COUNTY

Name of Grower.	Soil.	Variety and Yield Per Acre of Each.									
Geo. L. Deming, Cornish.	Early land.	No. 58	No. 85	No. 88	No. 82	No. 90	No. 93	No. 95	No. 91	No. 1	No. 92
		588 bu.	499.1 bu.	403.7 bu.	394.8 bu.	393.2 bu.	393.2 bu.	363 bu.	349.5 bu.	347.9 bu.	322.7 bu.
A. W. Fairbanks, South Cornish.	Clay loam.	No. 16	No. 35	No. 7	No. 27	No. 28	No. 44	No. 17	No. 3	No. 56	No. 76
		364 bu.	270 bu.	270 bu.	267 bu.	267 bu.	240 bu.	240 bu.	225 bu.	209 bu.	201 bu.
W. H. Howard, Grantham.	Gravelly soil.	No. 92	No. 95	No. 86	No. 91	No. 89	No. 88	No. 93	No. 85	No. 90	No. 82
		229.6 bu.	211.7 bu.	205.7 bu.	199.6 bu.	199.1 bu.	187.5 bu.	187.5 bu.	186.9 bu.	184.6 bu.	157.3 bu.
Wm. D. Lear, South Cornish.		No. 88	No. 93	No. 95	No. 85	No. 89	No. 91	No. 92	No. 90		
		390 bu.	293 bu.	273 bu.	273 bu.	231 bu.	234 bu.	234 bu.	195 bu.		
J. P. Smith, Sunapee.		No. 95	No. 92	No. 91	No. 82	No. 93	No. 86	No. 85	No. 88	No. 90	No. 89
		358.5 bu.	342.8 bu.	316.6 bu.	305.4 bu.	288.7 bu.	282.3 bu.	272.2 bu.	264.3 bu.	259.6 bu.	246.6 bu.
John Wood, Washington.	Heavy.	No. 77	No. 80	No. 1	No. 65	No. 58	No. 62	No. 75	No. 69	No. 88	No. 68
		843.6 bu.	786.5 bu.	786.5 bu.	786.5 bu.	786.5 bu.	756.2 bu.	726 bu.	695.7 bu.	695.7 bu.	695.7 bu.

Wm. D. Lear, So. Cornish.—"The potatoes you sent were planted on land that was broken in June, last year, and sowed to Hungarian, manured in the fall, and plowed in. In the spring was harrowed, and planted the first week in May. They were dug the last of August and first of September. Leonard's Favorite (44) were no good, one half scabby; also Sir William (65) of last year. The remainder will try again."

Geo. L. Deming, Cornish.—"The potatoes sent me last spring were planted on April 22 on a piece of early land sloping to the south and east. The soil was a greensward, and the only manure was applied in the hill, being horse manure, one shovelful in two or three hills, and about the usual amount of phosphate. When the potatoes came up, they were liberally dressed with ashes. I had a large growth of vines. I think I erred in using horse manure in the hill; think it better to plow it under; it also has tendency to cause scab. Of the varieties received two years ago, the White Star (72) were very

poor both years; Reeve's Rose (58), large yield, but large per cent. of small ones, very scabby; American Wonder (2), large yield, less small ones, quite scabby; Sir William (65), fair yield, less scabby."

A. W. Fairbanks, So. Cornish.—"The potatoes were planted upon a piece of ground having a southern slope, and a good clay loam. It had not been plowed for six or seven years, and without fertilization throughout this time. The fertilizer used was 800 pounds E. Frank Coe's Potato Fertilizer, on three fourths of an acre, one half in drill, and remainder broadcast. I cultivated twice and hoed once. The potatoes were very large, but rotted badly toward the last."

W. H. Howard, Grantham.—"The potatoes were planted May 18, on medium dry, gravelly soil, and were dug September 12, but the vines were dead September 1. The drouth of July seemed to hurt their growth to some extent. Think on this account they matured earlier than they would otherwise. Bovee (82), about one third small; Early Roberts (85), uniform shape, and good size; Fillbasket (86), of large size; Prolific Rose (88), hardly average size; Pride of the South (89), a light yielder, but few small; Early Michigan (90), same as (89); Algoma (91), good size and shape; Alexander Perfection (92), very large and fine shape; Burrns's No. 1 (93) about an average for size; Virgirosa (95), mostly marketable. With the exception of Fillbasket, there was little rot, about one sixth of the latter were affected."

J. P. Smith, Sunapee.—"The accompanying report of results with potatoes sent me is compiled from growing them in the common hardwood soil of this locality."

John Wood, Washington.—"My soil is deep, and rather heavy. I did not have but a very few rotten potatoes, this season, and no scab. All of the different kinds are very smooth. The bugs did not trouble me this year. I had eight feet of rows, and put two pieces in a hill. I used Coe's Fertilizer."

CULTURE

Experiments in potato culture have received the attention of this and many other experiment stations to a great extent in recent years. At present the various questions formerly in doubt are fairly well understood. Instead of going into the subject in detail, the writer has concluded to quote the summary of Farmers' Bulletin No. 35, "Potato Culture," U. S. Department of Agriculture, which covers the subject, and puts it in a very clear and condensed form, as follows:

(1) A rich, sandy loam, well drained, and well supplied with vegetable matter, is the best soil for the potato. Stiffer land may be improved as a potato soil by green manuring and drainage, and lighter soils can often be made sufficiently rich by the addition of green manures and fertilizers.

(2) Potatoes should not, as a rule, be grown continuously on the same land, but should be alternated with other crops. Barnyard manure may be freely used, but should, as a rule, be applied to previous crops in the rotation.

(3) If commercial fertilizers are used a mixture containing nitrogen in form of nitrate of soda, phosphoric acid as superphosphate, and potash as sulphate, and in which potash predominates, is recommended.

(4) Preparation of the land should be deep and thorough.

(5) Planting without ridging generally affords the larger yield, but a stiff soil and the desire for an extra early crop sometimes necessitates planting on ridges.

(6) The best time for planting depends upon the climate of each locality; the planting should be so timed as to bring the period when the tubers are rapidly forming at a date when the average rainfall is ample.

(7) On mellow, well-drained soil, deep planting (3 to 5 inches) is best, especially when the season happens to be dry. For the early crop, or on stiff soil with a tendency to bake, the depth of planting may be decreased.

(8) The use of the harrow before the plants are all up and frequent shallow cultivation afterwards until the vines shade the land are advisable.

(9) Seed potatoes grown in New England in several tests proved superior to Maryland seed both in New England and in Maryland. However, the data seem insufficient to determine definitely the relative value of seed potatoes from different climates.

(10) Cutting the seed pieces a few days before planting appears to exercise no injurious influence, provided, of course, that the cuttings are carefully stored in the interim.

(11) The yield from planting the seed or bud end is generally greater than from the stem or butt end of the tuber. The eyes on the seed end are the first to germinate, and hence are especially important when an early crop is desired.

(12) Exposing unsprouted tubers in a warm place before planting hastens growth, but if continued until sprouts form (which are rubbed off), the yield may be considerably reduced.

(13) Experiments indicate that it is more important to cut the tuber into compact pieces of nearly uniform size than to so shape the pieces as to have a definite number of eyes on each set. No piece should be entirely devoid of eyes, and the majority of the seed pieces should be large enough to support at least two eyes and better three or more.

(14) At distances of 1 by 3 feet, and with seed tubers averaging 4 ounces, an acre requires of quarters about 15 bushels.

(15) The total yield increases with every increase in the size of seed piece from the single eye to the whole potato; this increase occurs both in the large and in the small potatoes, but chiefly in the latter.

(16) The gross yield of salable potatoes (large and medium) also increases with the size of the seed piece from one eye to the whole potato.

(17) The net yield of salable potatoes (found by subtracting the amount of seed potatoes and the yield of small potatoes from the total yield) increases with every increase in the size of seed piece from one eye to the half potato. The half potato affords a larger net salable crop than the whole potato, on account of the excessive amount of seed required in planting entire tubers. Taking the average of many experiments it was found that for every 100 bushels of net salable crop grown from single eyes there were 114 bushels from 2-eye pieces, 131 bushels from quarters, and 139 bushels from halves, but only 129 bushels from planting whole potatoes.

(18) These results favor the use of halves as seed pieces if seed potatoes and crop are assumed to be of equal value per bushel, but when seed potatoes command a very high price quarters may be used to advantage.

(19) Large seed pieces afford an earlier crop and are less liable to result in a deficient stand or entire failure, which, in unfavorable years and poorly prepared soil, is sometimes the fate of small pieces.

(20) With judicious planting there is probably no necessity for reducing the number of stalks per hill by thinning.

(21) It is better to place in a hill one large piece than several very small ones of the same aggregate weight.

(22) Distance, variety, character of soil, and numerous other conditions are factors in determining the most profitable amount of seed. The distance allowed each piece should increase with the size of the piece, and should be greater with varieties with rank growth of vines and numerous tubers than for less vigorous varieties.

(23) Small potatoes can sometimes be used for seed with profit, in which case they should be planted whole. Leading growers are careful to select for seed medium to large tubers of good shape, and their example should be followed.

(24) In harvesting it pays to handle potatoes carefully, and this is especially necessary for early potatoes dug before the vines are completely dead, and while the skin is tender. Removing the largest tubers by hand, before growth ceases, does not necessarily reduce the yield, but is practicable only on small areas.

(25) Darkness and a low temperature are the primary requisites in the successful storing of potatoes.

(26) In warm climates a second crop can be obtained within one year by planting sprouted whole potatoes in midsummer.

REMARKS

1. The yield for each variety for the past season is found in Table I.

2. Table II represents the average yield of all varieties for the two potato years of 1896 and 1898.

3. The seventeen varieties giving the largest average yield, in order of productiveness, are given in Table III.

4. For cultural directions see page (70).

5. The coöperative potato tests with practical growers throughout the state have been classified into counties, and these arranged alphabetically,—Belknap page 54, Cheshire 55, Coös 57, Grafton 58, Hillsborough 62, Merrimack 64, Rockingham 66, Strafford 67, Sullivan 69.

6. No varieties for test purposes will be sent out this season.

7. The Experimental Station will be pleased to receive reports or seed thought to be of value at any time.

The Forest Tent Caterpillar

BY CLARENCE M. WEED

Bulletin 64 **April, 1899**

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

DURHAM

FIG. 20. Fragments of Leaves of Maple cut off by Forest Tent Caterpillars.

THE FOREST TENT CATERPILLAR

BY CLARENCE M. WEED

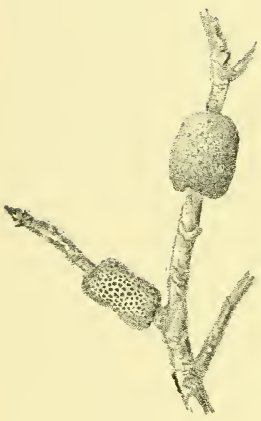


FIG. 21.—Egg Masses.

DURING the last three years, in many parts of New Hampshire and neighboring states, there has been a serious outbreak of the insect which has long been known as the Forest Tent Caterpillar, although in most regions where it has recently been present it is called the Forest Worm. It has attacked forest, orchard, and shade trees, and has done a great deal of damage in many regions of New England.

This is no new pest: for a century or more it has been known as a destructive insect. At frequent intervals in the past it has ravaged orchards and woodlands in widely separated states; from Maine to Texas severe attacks by it have been recorded.

These Forest Tent Caterpillars hatch from eggs which are deposited in cylindrical masses that form complete circles upon the smaller twigs of a considerable variety of trees. The appearance of these "caterpillar belts" is shown in Fig 21; the eggs are covered with a brittle substance which gives the mass a shiny appearance, especially in a bright light.

The young caterpillars or larvæ come forth from the egg in spring about the time the leaves of the trees begin to unfold. When first hatched they are tiny creatures, scarcely one-tenth of an inch long, showing under a lens that the blackish body is provided with a covering of long brownish or grayish hairs.

Wherever they go these little larvæ spin a silken thread which marks their pathway, although the thread is so slender that it is generally to be seen only through a lens.

The tiny caterpillars feed upon the tender leaves of the twig near where the egg mass was placed. In about two weeks each larva increases in size to such an extent that the skin in which it came from the egg is too small for it. This skin then splits open along the back, and the caterpillar crawls out clad in a new skin that had gradually been forming beneath the old one. This skin-shedding process is called moulting; it is the general way in which insects provide for increase in size. All sorts of caterpillars as well as other insects moult as they grow.

After the first moult the Forest Caterpillars begin feeding again, eating of course more and more of the foliage as they become larger. A week or so later they again moult, a process which is twice repeated thereafter at similar intervals. At the period of moulting the caterpillars are in the habit of congregating upon the trunks or larger limbs of the tree, often not far from the ground. Beneath the mass of larvæ there is an inconspicuous web in which the feet are more or less entangled. The appearance of the caterpillars at such times is well shown in the photograph reproduced in Fig. 24, for the use of which I am indebted to Dr. F. W. Russell, Winchendon, Massachusetts.

When the caterpillars become full grown in this, their larval state, each seeks a place in which to spin its cocoon. Many remain in the trees and tie up the leaves by silken threads, thus forming a partial or complete covering for the cocoon (Fig. 29). Others seek crevices in the rough bark, while many others—probably one-half or more of all the caterpillars—forsake the tree and wander off

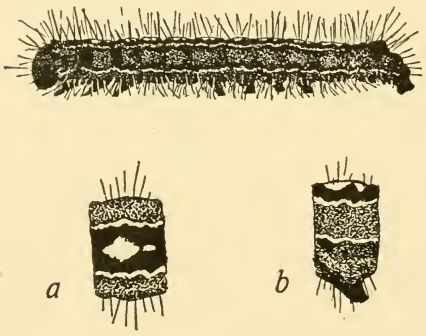


FIG. 22. Forest Tent Caterpillar; *a*, markings on one ring of the back; *b*, markings on one ring of the side.

in all directions, utilizing any shelter they may come upon. They commonly crawl up the sides of houses and other buildings, and form their cocoons along the clapboards or beneath the gables.

The cocoon is made of silk with an outer mass very loosely spun, and an inner mass so much more closely woven that it forms a web of almost parchment-like texture. As in the case of the American Tent Caterpillar, the threads of the cocoon are white when first spun, but become yellow by being saturated with a liquid which the caterpillar ejects shortly before pupation. As this liquid dries it leaves a yellow powder in the silk.

Soon after forming the cocoon around itself the caterpillar changes to the pupa or chrysalis condition, becoming an oval brown object without legs or wings, able to move only by a wriggling of its body. In this condition it takes no food, but within the quiet exterior the body of the caterpillar is being developed into that of a moth.

About ten days after the cocoon was made the pupa skin cracks open, and a brownish moth emerges from the cocoon: this is the adult condition of the Forest Caterpillar. The male moths are slightly smaller than the females, as may be seen from Figs. 23 and 25, the first of which represents the male and the second the female, both natural size.

The moths generally make their appearance the latter part of June. Soon afterwards the females deposit their eggs in masses of about two hundred each upon the twigs. The moths, having completed the cycle of life, die soon after the eggs are laid.

The eggs thus deposited early in July are to remain unhatched until the following spring. The actual formation of the tiny caterpillars from the contents of the egg takes place, however, within a few weeks after they are laid. The minute but fully-formed caterpillars may be found within the egg shells, by a careful examination, any time between September and the following April. The caterpillars remain during this long period quietly confined within

FIG. 23. Male Moth of Forest Tent Caterpillar. Natural size

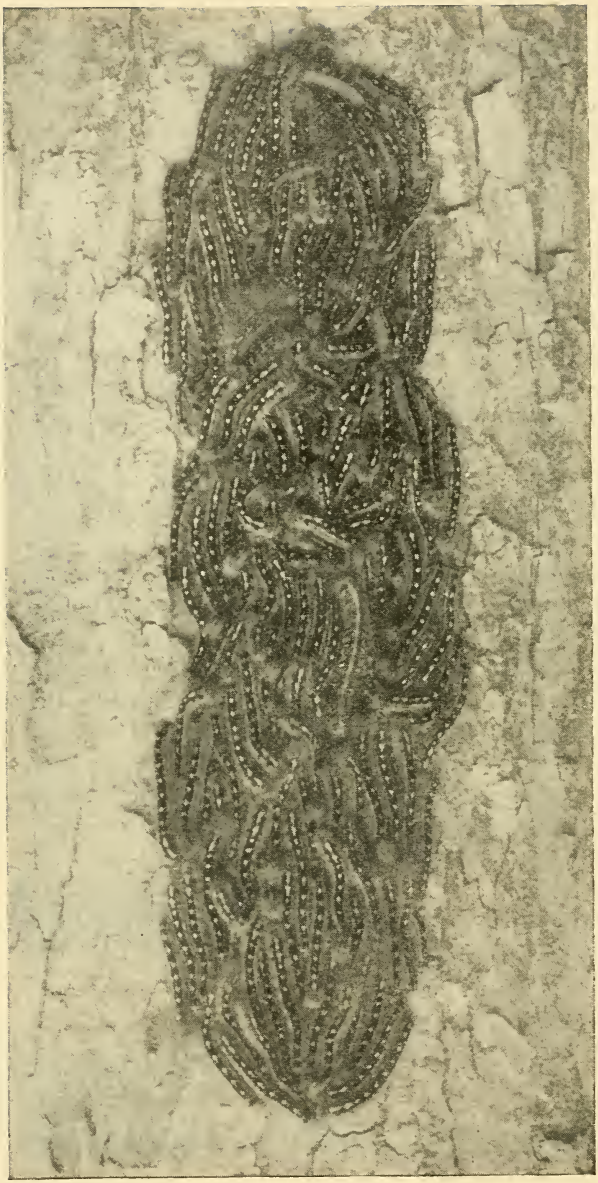


FIG. 24. A Mass of Caterpillars on the trunk of a Crab-Apple. (Photographed by Dr. F. W. Russell.)

their narrow houses, but when the warm rays of the spring sunshine penetrate their abodes, they eat off the tops of the egg-shells, and come out ready to break their long fast upon the tender foliage of the unfolding buds.

HABITS OF THE CATERPILLARS

The caterpillars very commonly emerge from the eggs some time before the leaves of their food-plants push out. Under such conditions the tiny larvæ are likely to huddle together upon or near the egg-mass to await the unfolding of the leaves. There seems to be considerable variation in the time of hatching, as larvæ of various sizes may be found at any time during the latter part of May or in June.

When the attack is not severe the caterpillars seem to keep to the upper parts of the tree, especially upon the ends of the outer branches. One correspondent in Sullivan county, New Hampshire, in sending cocoons July 29, 1897, wrote, "A very destructive pest is destroying the foliage of our maple grove. I send you a sample of the nests. There are millions of them. They seem to commence at the top of the tree and eat down. We do not see the insect at all. They seem to be hidden through the day at least."

Fig. 25. Female Moth of Forest Tent Caterpillar. Natural size.

In this instance the damage had evidently been done before the presence of the insect was known. Consequently it seems worth while for the owners of maple or other groves to keep a sharp watch upon their trees this season, even if heretofore they have not been injured.

When the caterpillars are disturbed while feeding upon the leaves or crawling along the twigs they have a habit of dropping downward, checking the fall by means of a thread spun from the mouth and attached to the twig. Thus suspended in mid-air they are very annoying to foot-passengers in villages or to people riding along shaded roads in town or country; for to find yourself suddenly confronted by a dozen caterpillars on the level of your face is disconcerting.

FIG. 26. Elm Leaves partially eaten by Forest Tent Caterpillars.

According to some observations made by my assistant, Mr. W. F. Fiske, to whom I am indebted for a number of observations upon this insect, the young caterpillars if suddenly disturbed while feeding will drop to the ground without attaching their threads. A large proportion of the caterpillars drop off by means of a thread at one time or another during their growth: some are probably startled by the swaying of the twig in the wind; others by birds when alighting; in many cases the movement is probably induced by the exhaustion of the food supply, or, perhaps, by a migratory instinct. In any event, this dropping is very general, and as a result the caterpillars are continually to be seen crawling up the trunks of the trees; this is especially likely to be the case early in the morning.

The larvæ generally crawl along the limbs in single file. As they go, each spins from its mouth a delicate silken thread.

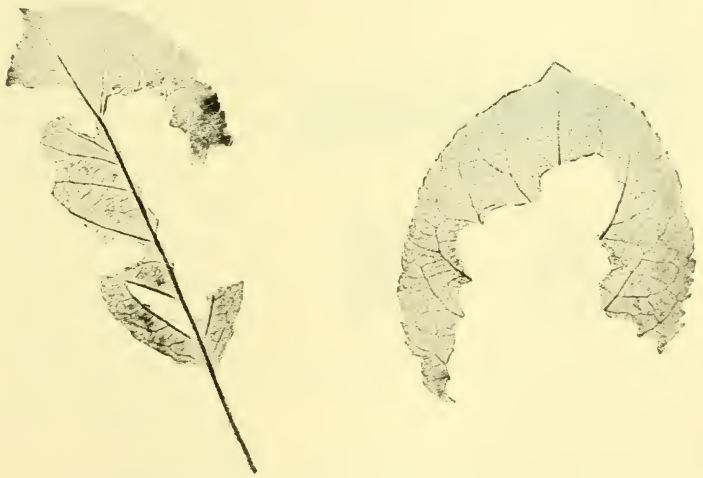


FIG. 27. Apple leaves partially eaten by Forest Tent Caterpillars.

When not eating, they congregate in masses upon the larger limbs, with an indistinct web beneath them, although generally there is no web over them, as is the case with the American Tent Caterpillar.

In feeding, especially as they approach maturity, the cater-

pillars commonly eat through the leaf in such a way that the outer end drops to the ground. Examples of this sort of injury are shown in Figs. 20, 26, and 27. The result is that in the case of the badly-infested trees the ground beneath is covered with these leaf fragments, which may be heard falling continually as the caterpillars work. This habit causes the insect to be relatively much more destructive than if it simply devoured the whole leaf because the tree is robbed of more of its leaf-surface, the damage done being somewhat analogous to that of the cutworms, which eat off the stem of a corn plant without devouring the leaves.

During the moulting periods, as well as during long-continued storms, the caterpillars collect together in great masses, resting upon a silken web attached to the bark of the tree. (Fig. 24.) Here they remain a day or two, until the old skins are sloughed off and the new ones are ready for use.

The caterpillar of this species is at once distinguished from the common American Tent Caterpillar by the differences in the markings of the line along the middle of the back. In the Forest Tent Caterpillar this line is interrupted, consisting of a series of white markings like that shown in the middle of Fig. 22, *a*, while in the common Tent Caterpillar the line along the middle of the back is continuous. (Fig. 28, *a*.)

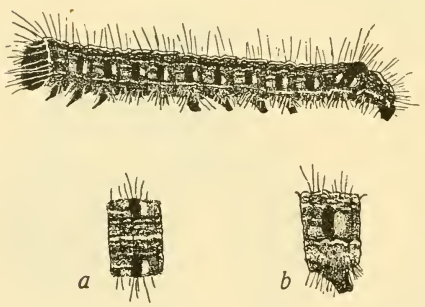


FIG. 28. American Tent Caterpillar; *a*, markings on one ring of the back; *b*, markings on one ring of the side.

The two species of caterpillars may frequently be found intermingled. Sometimes a brood of the Forest species will collect upon the outside of the tent of the common species.

When an orchard or grove in which the caterpillars have developed is defoliated, they will migrate to neighboring trees in a way suggestive of the migrations of the Army Worm.

At such times they may be seen in incredible numbers.

Several cases are on record where in crossing railway tracks they have impeded the progress of trains by making the rails slippery as the bodies were crushed. One case which has been vouched for by the entomologists of the United States Department of Agriculture, after official investigation, is reported in these words:

"The rails on the Carolina Central railroad were covered inches deep with caterpillars, so that for three days in succession trains were brought to a dead standstill, the driving-wheels of the engine slipping round as though the rails had been thoroughly oiled. The engineers were obliged to exhaust the contents of the sand boxes before crossing the strip of swamp from which the caterpillars seemed to come. The rails and cross ties were said to be obscured from sight, and the ground and swamps on each side of the track were covered with millions of the crushed caterpillars, and from the mass an unendurable stench arose." *

Those Forest Caterpillars which utilize leaves in forming their cocoons seem to have very little choice as to the leaves employed. In Vermont, Miss Caroline G. Soule, to whom I am indebted for a large number of observations upon this insect, found cocoons made in the leaves of the following plants:

Apple
Asparagus
Barberry
Cherry
Clover
Cut-leaved Birch
Elm
Ferns
Fountain Plant
Fringe Tree
Geranium
Grape
Grass
Hawthorn
Horse Chestnut
Hydrangea
Maple
Mountain Ash
Lilac
Pear
Plum
Smoke Tree
Syringa
Violet
Woodbine

Probably this list could be considerably increased by more

* Insect Life, Vol. iii, p. 477.

extended observations in other localities. Evidently the larvæ utilize whatever foliage they find available when the stress of cocoon making is upon them. A correspondent at Haverhill, New Hampshire, reported that she found "pine trees covered with the cocoons of the Forest Tent Caterpillar. The needles were tied together with their silk, and the cocoons inside of them." These leaf coverings are of all degrees of perfection from such a well-knit specimen as is shown in Fig. 29 to that of a cocoon in which two or three grass blades serve little more purpose than that of supporting the silken woof of the cocoon. Two or more cocoons are commonly spun within a single leaf, and trees frequently appear "bunched up" from the action of the caterpillars. Numerous observations indicate that normally about as many caterpillars spin cocoons in leaves as out, but the proportion would be likely to vary with the conditions present in a given locality.

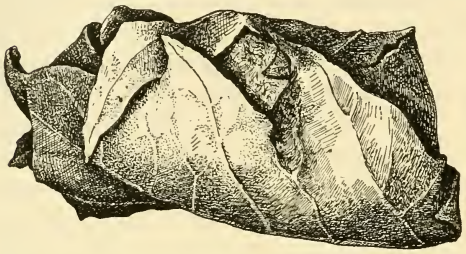


FIG. 29. Cocoon of Forest Tent Caterpillar in a maple leaf. Natural size.

FOOD PLANTS

This Forest Tent Caterpillar is a very general feeder, attacking many more kinds of plants than does the American Tent Caterpillar. In the various articles which have heretofore been published the following food-plants are recorded:

Apple	Oak
Ash	Peach
Beech	Plum
Birch	Poplar
Cherry (wild and cultivated)	Rose
Hawthorn	Sour Gum
Hickory	Sweet Gum
Linden	Walnut
Maple	

During June, 1898, Miss Soule observed these caterpillars in the vicinity of Brandon, Vermont, feeding upon the following species:

Apple	Purple Beech
Barberry	Rose
Cherry (wild and cultivated)	Smoke Tree
Currant	Horse Chestnut
Diervilla	Linden
Elm	Lilac
Fringe Tree	Locust
Hawthorn	Magnolia
Mountain Ash	Swamp Fly Honeysuckle
Pea Vines	Willow
Pear	Woodbine
Peonies	White Birch
Plum	

The caterpillars have also been abundant upon oak, poplar, and various other trees.

HABITS OF THE MOTHS

Like most moths the adults of these Forest Caterpillars are night-fliers rather than day-fliers. They are attracted by light after dark, and frequently fly through open windows into houses. Late in the afternoon they may also be seen when abundant, flying among the branches of the trees.

I have not seen the moth while depositing the eggs, but the process has been described by Dr. C. V. Riley as follows: "These eggs are deposited in circles, the female moth stationing herself for this purpose, in a transverse position across the twig. With abdomen curved, she gradually moves as the deposition goes on, and when one circle is completed she commences another, and not before. With each egg is secreted a brown varnish, which firmly fastens it to the twig and to its neighbor, and which, upon becoming dry, forms a carinated net-work of brown over the pale egg-shell. These eggs are so regularly laid and so closely glued to each other, and the sides are often so appressed, that the moth economizes space

almost as effectually as does the honey-bee in the formation of its hexagonal cells."

ABUNDANCE AND INJURIES

The injuries caused by these caterpillars have been serious and widespread. In many regions they have defoliated the maples of sugar groves. In some cases the trees have been killed, while in others their vitality has been so weakened that they became, at least temporarily, of little value for sugar production. When syrup is made from such trees, it is of such inferior quality that it is often locally called "buggy syrup." All through the infested regions hillsides may be seen in which the woods are brown and bare from the attacks of the caterpillars.

It is difficult for one who has not seen an outbreak of such a pest as the Forest Caterpillar to get an adequate conception of the enormous numbers which may be present. They have been collected, quarts at a time, in many localities, and are often so abundant on the trunks of trees as to conceal the bark from view. An idea of the mass which may migrate from one place to another may be obtained from the account already given of their stopping railroad trains (p. 85).

The effect of a sudden onslaught of an army of these caterpillars migrating from a neighboring woodland to an apple orchard may be disastrous. Defoliation may take place in so short a time that the leaves are gone before the presence of the caterpillars is known. In many cases a new crop of leaves will be put out, but the vitality of the trees is necessarily impaired.

DATES OF TRANSFORMATIONS

The statement has already been made that there is considerable variation in the time of hatching of the caterpillars. By the middle of June, when some of the larvæ had become full-grown and spun cocoons, others had only moulted once, and many others only twice. The majority of the caterpillars spun up by June 25, and practically all by the 30th of the same month. Many of these caterpillars which spun latest were much smaller than the normal size. The earliest moths emerged about June 24.

DESCRIPTION OF THE LIFE STAGES

Egg. — The egg mass of this Forest Caterpillar is in the form of a belt encircling the smaller twigs of the various food-plants. Its general shape is represented in Fig. 21, the length of the belt varying from one-fourth to one-half of an inch; the diameter is usually one-fourth of an inch. The belt terminates abruptly at each end, although it is not as a rule squared off. The outside of the belt consists of a glistening, varnish-like, brownish or lead-gray material, which covers the eggs. When the eggs are first laid, and for some months afterward, this covering remains entire, but as the winter passes, it becomes more and more broken, so that by spring it generally has a rather ragged appearance. By removing the covering, the eggs will be found beneath, resting side by side at right angles to the supporting twig. Each egg is a trifle longer than wide, and is covered with a reticulated net-work of the same varnish-like material that conceals the mass as a whole: this net-work serves to attach the eggs to the twig and to each other. The eggs are of a dull gray color, showing white in some places. When the caterpillars hatch they gnaw off a circular cap on the upper end of the egg, and come out through the hole thus made. Each egg is about one-twentieth of an inch long. The number of eggs in one belt varies from less than 150 to more than 225, the average being nearly 200.

Larva.—The full-grown Forest Tent Caterpillar has a cylindrical body about two inches long and a little more than a quarter of an inch thick. It is rather sparsely clothed with brownish hairs. The general color is bluish. Along the middle of the back there is a series of double whitish or cream-colored spots having the appearance of Fig. 22, *a*. By means of these spots the caterpillar may easily be distinguished from the common American Tent Caterpillar; in the latter species the line along the middle of the back is continuous (Fig. 28, *a*). On the upper part of each side of the Forest Caterpillar there runs a rather broad blue line, edged above and below with a narrow, yellowish-brown line. The head is bluish. Near the front end of the body are three pairs of jointed legs, each with a

hook-like claw at the tip. Along the middle of the body are four pairs of thicker prolegs, and at the hind end is another pair of prolegs.

Pupa.—The pupa when removed from the cocoon is a brownish object without legs or wings or other external organs. It is about three-fourths of an inch long by one-fourth broad at its widest part, although the male pupa is noticeably smaller than that of the female.

Moths.—An idea of the general appearance of the moths may be obtained from Fig. 23 which represents the male, and Fig. 25 which represents the female, both natural size. As will be seen the former is the smaller. The general color is a buff brown with an oblique band of a deeper tint across each front wing. The "feelers" or antennæ of both sexes are feathery, those of the male being the broader.

NAMES

The accepted scientific name of this species is *Clisiocampa disstria*, although it was formerly called *C. sylvatica*. Its common name, Forest Tent Caterpillar, is not very satisfactory, because, first, the insects are as likely to be found in apple orchards as in forests, and, second, they do not make tents in the complete sense that the nearly-related American Tent Caterpillar does. But the insect has always been called the Forest Tent Caterpillar in our literature, and the name may as well be retained until one more satisfactory is suggested.

Many people have been needlessly alarmed by the thought that this was the famous Gypsy Moth Caterpillar. It has nothing to do with that notorious insect, although it may well serve as an illustration of what would be likely to take place if the Gypsy Moth should become widespread.

NATURAL ENEMIES

These Forest Tent Caterpillars are preyed upon by many natural enemies, including insects, spiders, toads, and birds. Among the more important insect enemies are certain ichneumon flies, similar to Fig. 30, which deposit eggs within the bodies of the caterpillars. These eggs hatch into grubs that

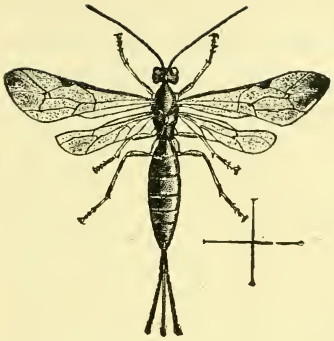


FIG. 30.—An Ichneumon Fly, magnified.

develop at the expense of the caterpillars, finally killing them. There are various other insect enemies.

A curious habit of a common species of Harvest-spider, or Daddy-long-legs, was observed by Miss Soule. On June 18 she wrote: "On almost every mat of Clisiocampa larvæ we find several 'daddy-long-legs,' sometimes as many as twenty. I have watched them closely and can see no reason for their being there." A week later she wrote again: "It seems this morning as if almost every larva was attended by a 'harvester,' which apparently stroked it with a leg or two or merely stood near or over it. Sometimes the touch made the larva curl up, but more often it seemed to have no effect. It is very curious, and I watch and watch but can learn nothing." The species concerned seemed to be the common Striped Harvest-spider,* as I judged from some half-grown specimens sent by Miss Soule. As to the reason for their presence I can only conjecture that they found food in connection with the caterpillars in some way.

Toads were seen to devour many of the caterpillars, although of course these creatures are comparatively so rare that they could make little impression upon the pests.

Birds, however, did a great deal toward reducing the numbers of the insects. Miss Soule observed robins, orioles, chipping sparrows (Fig. 32), cat birds, cuckoos, the red-eyed, white-eyed,

FIG. 31. The Chickadee.

* *Litbunum dorsatum.*

and warbling vireos, cedar birds, and nuthatches feeding upon the caterpillars. The nuthatches, according to Miss Soule's account, "would stand by a patch of larvæ lying close together below a tar band on a tree and eat so voraciously and with such an entire abandonment of self-consciousness that I could go close and put my hand on them before they would fly. This experience was repeated several times." The cocoons were attacked by chickadees (Fig. 31), which tore open the cocoons and fed upon the pupæ, as well as by nuthatches. The moths were also eaten in great numbers by many sorts of birds, including robins, chipping sparrows, yellow birds, and even English sparrows, although this last-named species apparently did not eat the caterpillars.

FIG. 32. The Chipping Sparrow.

In some localities the Forest Tent Caterpillars were attacked by what appeared to be a bacterial disease similar to the one which destroyed so many of the American Tent Caterpillars in southern New Hampshire in the summer of 1898. (See Bulletin 59, p. 202.) It is to be hoped that the present season it may complete its work, for this is probably the agency that is most likely to check the outbreak. Its destructive effect is likely to be increased by weakness in the caterpillars, due to the partial exhaustion of the food supply. There was also evidence that a fungus disease called "muscardine" was at work among them.

REMEDIAL MEASURES

Many remedial measures have been proposed at various times to prevent the injuries of the Forest Tent Caterpillar.

The practical value of most of these measures depends largely upon the conditions under which they are to be applied. A suggestion that is easily applicable to a few small trees in an apple orchard may be wholly inapplicable to the large trees in a woodland.

The abundance of the caterpillars, the nature and number of the trees infested, the season of the year, and the means at hand are all to be taken into consideration. In the following paragraphs I have summarized the measures which a careful study of the subject leads me to think will prove of value. They are arranged according to stage of growth—from egg to moth—to which they are to be applied.

Egg Destruction.—On a bright day, when the trees are bare of leaves, the egg-masses may be easily seen. The cutting off and burning of these masses is often practicable in a young apple orchard, although it is generally considered impracticable in orchards of large trees. It generally would be out of the question in woodlands, of course, although in case of a few ornamental maples or other trees on the home grounds, such egg-collecting might well be worth while. The gathering may be done by sending a sharp-eyed boy into the trees to cut off the glistening masses, or by means of a pruning-hook or a pair of long-handled pruning-shears. The belts of eggs should be burned after they are gathered.

Killing the Young Caterpillars.—On small trees, where the caterpillars are easily reached, something may be accomplished by swabbing the colonies of young larvæ when at rest by means of a bunch of cotton waste, old rags, or something similar. In rainy weather, one is more likely to find the larvæ massed together during the day than in bright weather.

Spraying with Poisons.—For the apple orchards, so far as concerns the caterpillars which hatch there, perhaps the simplest way of destroying these pests is to spray the trees with arsenites early in the season, before the caterpillars are half grown. After the leaves are unfolded and the caterpillars have begun work, the earlier this spraying is done the better, except that it should not take place when the trees are in bloom. The common practice in spraying is to add four or

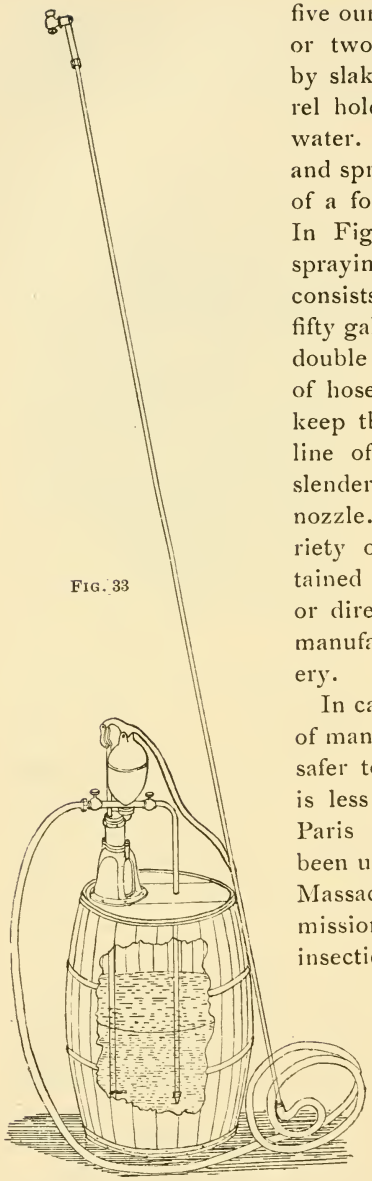


FIG. 33

five ounces of Paris green and a pint or two of fresh lime-water—made by slaking lime in water—to a barrel holding forty or fifty gallons of water. This is thoroughly mixed and sprayed upon the trees by means of a force pump and spray nozzle. In Fig. 33 a simple and effective spraying outfit is represented. It consists of a kerosene barrel holding fifty gallons, a force pump having a double discharge, with a short line of hose running into the barrel to keep the liquid stirred, and a long line of hose fitted at the end to a slender brass rod tipped with a spray nozzle. This outfit, or a great variety of similar ones, may be obtained through any hardware dealer or direct from any of the numerous manufacturers of spraying machinery.

In case it is desired to spray trees of many sorts, it would probably be safer to use arsenate of lead, which is less liable to injure foliage than Paris green. This substance has been used in great quantities by the Massachusetts Gypsy Moth Commission. It has been found a safe insecticide for all sorts of trees. It is not generally on sale in the market, but can be made according to the following directions of Professor C. H. Fernald:

"Arsenate of lead is easily prepared by putting 11

ounces of acetate of lead in 4 quarts of water, in a wooden (not metal) pail, and 4 ounces of arsenate of soda (50 per cent.) in 2 quarts of water, in another wooden pail, and when entirely dissolved mixing them in a hogshead containing 150 gallons of water, when a chemical reaction will take place, forming arsenate of lead as a fine white powder in suspension in the water. If cold water be used in the wooden pails, the solution of the acetate of lead will require a little time; but, however, if the water be hot, it will dissolve very quickly. It is customary to add from 2 to 4 quarts of glucose to the above amount of water. If it is desired to use larger proportions of the arsenate of lead, it is only necessary to use more acetate of lead and arsenate of soda, but in the proportions given above."

Another substance which has lately been put upon the market as a substitute for Paris green, is called Green Arsenite. It is a finer powder than Paris green and generally costs at retail, 15 cents a pound. It can be purchased of dealers generally, or direct of the manufacturers—the Adler Color and Chemical Company, New York. One great advantage it has over Paris green, is that being a finer powder it remains in suspension much longer. A little lime water should be added to the mixture as in the case of Paris green. It is to be used at the rate of four or five ounces to fifty gallons of water.

Killing the Older Caterpillars.—After the caterpillars are half-grown they commonly come down to the lower branches or the trunk to undergo the moulting process. To this end they gather in great masses on the bark, where they may be destroyed by means of a stiff broom—more effective perhaps if frequently dipped in kerosene,—or by collecting the caterpillars in pails containing a little kerosene and water. In the towns and villages throughout the infested regions vast numbers of the pests were destroyed in these ways, especially the latter, in 1898.

Banding.—The fact that so large a proportion of the caterpillars drop off the trees from time to time and return by crawling up the trunks, has led to the quite general use of bands of various materials upon the trunk to prevent the ascent of the larvæ. Tar has been quite generally applied for this purpose, but it is objectionable as it does not remain effective long, so

that the caterpillars are soon able to cross over it. Sticky fly-paper—"Tanglefoot"—has been commonly used with a large degree of success; it is effective, cheap, and easily applied. Rather wide bands of it are necessary to prevent bridging over by the dead or dying caterpillars. The chief difficulty with this paper is its liability to injury by rain, the wetness causing it to tear so readily that it may not last long. In some cases bands of greased tin have been successfully employed.

A better substance than any of these, however, is Raupenleim or "Caterpillar-lime," a material manufactured in Germany for application to the bark of trees to prevent the ascent of caterpillars and other crawling insects. It is to be put on as a rather wide band, or as two narrower bands. In the case of large trees with thick bark the material may be smeared directly upon the bark, while in the case of young trees and those with smooth bark it is safer to apply the Raupenleim by smearing it upon a band of heavy wrapping paper or some other thick and firm paper tacked upon the tree. Any loose bark may be scraped off the portion of the trunk which is to be covered by the paper before the latter is put on; and it is sometimes worth while to insert a thin layer of cotton waste, or some similar material, beneath the paper to fill up crevices and thus prevent any insect from crawling through beneath the paper. Then the Raupenleim may be smeared upon the paper the thickness of about a quarter of an inch, and left as long as it remains sufficiently sticky to entrap any insect that attempts to crawl over it. As it will remain eight or ten weeks in a sticky condition, a single application early in the season will probably last until danger from the caterpillars is past.

It should be distinctly understood that there may be danger of injuring trees with smooth and thin bark if this Raupenleim is smeared directly upon the bark. For young trees and those older which have a smooth bark I recommend that the Raupenleim be applied by placing it upon strips of thick paper tacked to the trunks of the trees. Even in the case of bearing apple trees this would probably be the safer method, and it should always be adopted for peach trees, if not for pear trees also. After the Raupenleim has been on some weeks the sur-

face hardens into a crust, and it is advisable to scrape off this crust after the danger from caterpillars is past. Too much of the rough bark should not be scraped off of the older trees to which the band of Raupenleim is to be applied, unless paper is to be used.

After the trees are thus banded, the caterpillars will collect beneath the bands, and, of course, are to be killed by means of a stiff broom, or any other method one may choose.

The American distributers of Raupenleim are William Menzel & Co., 64 Broad St., New York, N. Y. In New England it can be purchased through the Bowker Fertilizer Co., Boston, Mass., and probably other dealers. It is put up in five-pound cans, costing about $1.00 per can; or in kegs holding 25 pounds, costing $3.75 per keg. Larger kegs are proportionately cheaper.

Jarring and Banding.—It has already been stated that these caterpillars drop downward when disturbed, breaking the fall by means of a thread spun from the mouth; although when young and suddenly jarred apparently the thread may not be used. This habit leads to the suggestion that by a combination of jarring and banding much injury may be prevented, at least in the apple orchard and on the home grounds. After the trees infested have been banded with the caterpillar lime, a boy with a padded mallet may be sent into them with instructions to jar the limbs on which the caterpillars are working, beginning at the top. This should be done when the caterpillars are feeding upon the leaves as they are then much more easily disturbed than when they are at rest. Of course it is not to be expected that going over once will wholly rid the tree, but by two or three repetitions of the jarring most of the caterpillars should be removed. In case they hang too persistently by their threads many of them may be swept out of the air by use of a long, light pole. This will lead the caterpillars to congregate in masses upon the trunk below the bands of Raupenleim, where they may be destroyed by use of a stiff broom or by various other methods. The earlier this is done after the larvæ are all hatched the less will be the injury to the foliage.

The masses of caterpillars beneath the bands are sometimes

killed by pouring on kerosene. If this method is employed great care should be taken not to add enough to saturate the bark. Many trees have been killed by carelessness in such use of kerosene.

Banding to Prevent Invasion.—In case of an uninfested apple orchard in the vicinity of an infested woodland, it will be advisable to band the apple trees with Raupenleim before the caterpillars are half grown to prevent invasion from them. The same advice would hold in case of other uninfested trees in the vicinity of those infested.

Collecting Cocoons.—A large proportion of the cocoons are commonly spun where they can be reached. The destruction of these will lessen the number of moths that lay eggs for the next season's brood of caterpillars, although it will also lead to the destruction of large numbers of parasites. If the cocoons were placed in a good-sized box with coarse-meshed mosquito netting over it the escape of the moths might be prevented while the parasites might get away to continue their good work. By a little trouble the moths remaining in the box could be killed.

Attracting Moths to Light. Like many other night-flying insects the moths of the Forest Tent Caterpillar are attracted to lights at night. This has led to the suggestion that they may be destroyed by placing a lighted lantern over a tub or other wide vessel containing water with a film of kerosene on top. The moths fluttering about the light will fall into the kerosene and be killed. Such destruction will lessen the number of eggs for next year's brood of caterpillars.

Bulletin 65 May, 1899

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

Notes on Apple and Potato Diseases

Leaf Spot of Apple

BY H. H. LAMSON

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

DURHAM

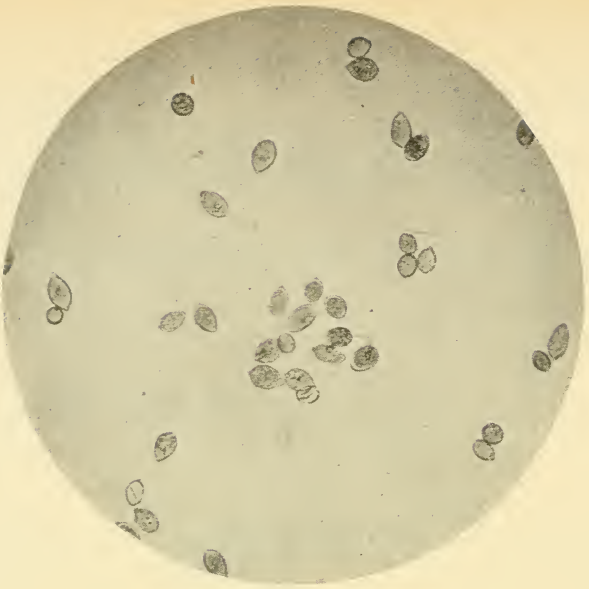


FIG. 35.—Spores of Late Potato Blight. Magnified.

FIG. 36.—Spraying Potatoes.

Notes on Apple and Potato Diseases in 1898

BY H. H. LAMSON

The principal fungous diseases of the potato are the *scab*, the *early blight*, and the *late blight*. Each of these is due to a minute parasitic plant which finds in the potato a congenial host plant, and develops on it to its serious damage. The *scab* attacks the tubers, the *early blight* the leaves, and the *late blight* all parts of the plant producing in the tubers the disease known as *potato rot*. Each of these diseases is propagated by means of spores or germs which bear the same relation to the fungous plant that seeds do to the higher plants.

POTATO SCAB

This disease affects the surface of the tubers, producing the familiar scabby or scurfy appearance. The crop is infected either by germs on the seed planted or by germs already present in the soil derived from a previous crop. These facts lead to the following practical suggestions as to treatment of the disease: Plant seed known to be free from scab or seed which has been freed from living germs by some method of disinfection; do not plant on ground from which a scabby crop has previously been taken.

Since under ordinary circumstances it is difficult to obtain seed entirely free from scab germs, some method of disinfection becomes an important consideration. Three substances in particular have been recommended for this purpose, corrosive sublimate, formaline, and sulphur.

Corrosive Sublimate.—In previous bulletins of this Station experiments have been described in which this substance was used with profitable results. The following additional experi-

ments are here reported. In these experiments the potatoes were planted on ground which had probably not been used for this crop for many years at least. The seed potatoes selected were badly scabbed. Part of the seed was planted untreated; the other part was treated with corrosive sublimate in the manner to be described later. Treated and untreated seed was planted in plots side by side, under similar conditions of soil and fertilzation. When the potatoes were harvested the untreated plots in field A, gave 48 per cent. scabby, and 52 per cent. free from scab; the treated plots gave 17 per cent. scabby, and 83 per cent. free from scab; a gain of 31 per cent. in favor of the treatment.

A similar experiment in another field (field B) gave from untreated seed 35 per cent. scabby and 65 per cent. free; from treated seed, 13 per cent. scabby and 87 per cent. free, or a gain of 22 per cent. in favor of the treatment.

Method of Using Corrosive Sublimate.—Dissolve corrosive sublimate in water at the rate of one ounce to eight gallons of water. Keep this solution in a wooden vessel; a barrel, half barrel, or washtub will answer the purpose. Put the potatoes to be treated in a coarse sacking bag, and plunge in the solution; let them remain for an hour and a half, moving them about occasionally to insure thorough wetting; then dry the potatoes, and they are ready for planting. Care should be taken that they do not become contaminated again by dirt from untreated potatoes. It should be remembered that corrosive sublimate is a violent poison if taken internally, therefore care should be taken in using it.

Formaline.—This is a liquid which has recently come into prominence as a valuable disinfectant. It is sold under various names, "Formalin," "Formine," "Formalose," "Formaldehyde," and is usually a 40 per cent. solution of formaldehyde gas in water.

In our experiments with this substance as a remedy for potato scab two strengths were used, viz.: One pint to 32 gallons of water, and one pint to 21 gallons of water. The potatoes were soaked in these solutions for two hours. They were planted alongside the corrosive sublimate plots in field A, and under the same conditions, the same untreated plots serving as checks

for both. As above, the untreated plots gave 48 per cent. of scabby potatoes and 52 per cent. scab-free. The plots treated with the stronger solution of formaline gave 13 per cent. scabby and 87 per cent. scab-free; a gain of 35 per cent. in favor of the treatment. The plots treated with the weaker solution gave scabby, 21 per cent., scab-free, 79 per cent.; a gain of 27 per cent. in favor of the treatment. These results indicate that formaline is an effective remedy for the scab, and in the strengths used above rivaling corrosive sublimate. It possesses advantages over corrosive sublimate in being less poisonous and more easily applied, but with the data at hand we are not yet ready to recommend its substitution for that remedy.

Influence of Different Fertilizers on Development of Scab.—The following table summarizes the results of experiments in regard to this point. The experiments with different fertilizers were crossed with those on the treatment of the scab on the same plots.

		Field A.		Field B.		Previously reported.	
		Treated.	Untreated.	Treated.	Untreated.	Treated.	Untreated.
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Phosphate.....	Scab free.....	83	53	79	89	92	63
	Scabby.....	17	47	21	11	8	37
Stable manure...	Scab free... ..			80	60	97	86
	Scabby.....			20	40	3	14
Plaster.....	Scab free.....					88	44
	Scabby.....					12	56
Air slaked lime..	Scab free.....	89	47	100	58		
	Scabby.....	11	53	0	42		
Wood ashes.....	Scab free.....	70	34	95	28	90	59
	Scabby.....	30	66	5	72	10	41
No fertilizer.....	Scab free.....	90	73	95	81		
	Scabby.....	10	27	5	19		

FIG. 37.—Germinating Spores of Early Blight. Magnified.

From these not wholly concordant results we prefer rather to point out indications than to draw final conclusions.

The indications are that, first, all of the fertilizers named may favor the development of the scab to a greater or less degree; hence as fertilizers cannot be dispensed with, the greater advisability of treating the seed. Second, air-slaked lime, plaster, and ashes are especially likely to increase the amount of scab.

POTATO BLIGHTS OR "RUSTS"

As indicated above there are two forms of "*blight*" or "*rust*," the *early* and the *late*. There is usually little difficulty in distinguishing between the two. The *early blight* appears in June or July, the *late* in August. The *early blight* presents numerous sharply-outlined, dark brown spots on the leaves; the *late* blight manifests itself as a progressive withering or dying of the leaves, spreads more rapidly than the *early*, and usually presents a readily seen white mold-like growth on the under side of the leaves. Both diseases often appear together, especially on late varieties. Both of these diseases are spread

by spores. Fig. 37 shows the curiously shaped spores of the *early blight* germinating preparatory to infecting the host plant. Fig. 35 shows the egg-shaped spores of the *late blight*.

Repeated experiments have shown that both these diseases may be profitably controlled by spraying with the Bordeaux mixture.

When to Spray.—For *early blight* on early potatoes, spray when the vines are about two thirds grown or as soon as the disease makes its appearance; repeat the spraying in about two weeks.

For both *early* and *late blight* on late potatoes spray three times; the middle of July, the first of August, and the middle of August.

Rainy weather may render it advisable to spray at shorter intervals and to increase the number of sprayings.

Spraying Outfit.—Fig. 36 shows a convenient outfit for potatoes or fruit trees; a pump specially designed for spraying mounted on a barrel of about 50 gallons capacity drawn on a wagon with one man to pump and another to apply the spray. In spraying potatoes a liberal length of hose should be used; we use fifty feet or more. A farmer naturally hesitates to drive over a field of thrifty "tops," but the injury is hardly to be considered as against the benefit of spraying. With a good length of hose the necessity of driving over the field is reduced to a minimum.

Effect of Bordeaux Mixture on Insect Injuries.—In this regard the following is of interest. A field was sprayed three times with Bordeaux mixture, a strip across the rows on one side was left unsprayed as a check. Between the first and second sprayings the unsprayed vines died. No fungous trouble could be detected, nor were the "slugs" of the Colorado beetle present, although many of the mature beetles were. The *flea beetle*, however, was present and was probably the chief cause of the destruction of the vines. The sprayed vines lived. A strip of the sprayed potatoes of the same area as the unsprayed and lying next to it yielded a little more than three times as many marketable potatoes. Bordeaux mixture is probably one of the best remedies against the flea beetle. (See Bulletin 29 of this Station.)

APPLE DISEASES

Spraying experiments on apples during the season of 1898 were not made with reference to any particular disease, but against any disease that might make its appearance. The trees sprayed were mostly Baldwins. The diseases which developed were those shown in Fig. 38, characterized by small brown

FIG. 38.—Brown Spot of Baldwin.

spots on the surface of the fruit; in Fig. 39, characterized by black or sooty diffuse blotches of no appreciable thickness, also on the fruit; and in figure on title page, characterized by small, round, reddish-brown spots on the leaves. The latter disease, which is caused partly at least by *Phyllosticta pirini*, in some cases does quite serious damage. The two other diseases seem to injure the fruit chiefly by rendering it unsightly.

The trees were sprayed three times with 1 to 10 Bordeaux mixture once before blossoming, again just after the fall of the petals, and a third time about two weeks later. Paris green was added to the mixture at the second spraying for the codling moth.

The following table shows the results:

		Nearly or quite free from spots.	Spotted.	Badly spotted.
Brown spot on Baldwin,	Unsprayed,	48 per cent.	44 per cent.	8 per cent.
	Sprayed,	78 "	18 "	4 "
Sooty spot on Baldwin,	Unsprayed,	17 "	63 "	20 "
	Sprayed,	83 "	14 "	3 "
Sooty spot on Greening,	Unsprayed,	18 "	57 "	25 "
	Sprayed,	77 "	33 "	0 "

The Greening seems to be free from the brown spot but is very apt to be disfigured by the sooty spot.

Brown Spot of the Foliage.—In all of our spraying experiments during the past four or five years, the Bordeaux mixture has appeared to have but little if any effect upon this disease.

Apple Scab.—This disease has done but little damage to Baldwins in this part of the state at least for three or four years.

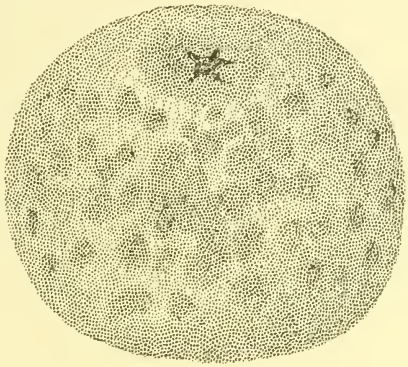


FIG. 39.—Sooty Spot of Apple.

When it does make its appearance on this or other varieties it readily yields to Bordeaux mixture. The same is true of the *scab* and *cracking* of pears.

When to Spray for the Fungous Diseases of the Apple and Pear.—Spray once before the blossoms open, again as soon as the petals fall, and a third time two weeks later. As in case of potato diseases the number of sprayings may have to be increased in rainy weather.

BORDEAUX MIXTURE

The Bordeaux mixture continues to recommend itself as the best all-round remedy for fungous diseases. It is efficient, it is cheap, and it is easily prepared when one once gets the "hang" of it and is willing to take pains. Directions should be carefully followed by those who are unfamiliar with its preparation.

The ingredients of the Bordeaux mixture are blue vitriol, lime, and water. The ingredient which kills the fungus is the

blue vitriol. The purpose of the lime is to prevent the injury to the foliage which a simple solution of blue vitriol would cause.

The proportion of the ingredients may be varied considerably. The formula which was recommended in Bulletin 27 of this Station still seems to us a satisfactory one, namely:

Blue vitriol	1 lb.
Lime, fresh	⅔ "
Water	10 gals.

As the quantity most frequently prepared would be a barrel the formula may be given as follows:

Blue vitriol	5 lbs.
Lime	3⅓ lbs.
Water	1 bbl. (45 to 50 gals.)

For the details of preparation see Bulletin No 45 of this Station.

Bulletin 66 **September, 1899**

NEW HAMPSHIRE COLLEGE
AGRICULTURAL EXPERIMENT STATION

Experiments in Pig Feeding

BY CHARLES WM. BURKETT

I. Pumpkins, Raw and Cooked; Apples and Pumpkins; Cornmeal and Bran; and Cornmeal

II. Bran Fermented and Unfermented; Bran and Cornmeal; and Cornmeal

III. Corn and Cob Meal; and Corn on Ear

NEW HAMPSHIRE COLLEGE
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EXPERIMENTS IN PIG FEEDING

BY CHARLES WM. BURKETT

Dairying and the raising of pigs go hand in hand in New Hampshire. The latter is necessary for the profitable utilization of the skim-milk, while the former is one of the leading agricultural industries of the state.

Among the chief points of practical interest and importance in pig feeding are the kinds of feeding stuffs to use in connection with skim-milk, and the most economical way to use them.

Experiments with the following combinations of feeding stuffs have recently been conducted at this station and the results are given in this bulletin:

I. Pumpkins, cooked and uncooked; apples and pumpkins; cornmeal; cornmeal and bran.

II. Bran, fermented and unfermented; bran and cornmeal; cornmeal.

III. Corn and cob meal; corn on ear.

These experiments were conducted during the past year with pigs raised at this station. The pigs were a cross of Chester white sows and a Berkshire boar. Up to the time of the experiments they were fed a ration consisting of skim-milk, corn, and middlings.

EXPERIMENT NO. I.

PUMPKINS, COOKED AND UNCOOKED; APPLES AND PUMPKINS; CORNMEAL AND BRAN; CORNMEAL.

This experiment as planned and conducted was to determine the effect of cooking pumpkins and apples, comparing them cooked and uncooked with cornmeal and cornmeal and bran. Bran was used in this and the second experiment because many New Hampshire farmers purchase bran as a dairy food, and from this quantity the pig food is taken to feed in connection with the skim-milk.

Pumpkins were raised at this station at a cost of 40 cents per ton, and while it is often said that pumpkins are principally hollow space and water it should be noted that the cost of production is next to nothing. The apples used were the common cider apples, or windfalls, and valued at 10 cents per bushel, the price usually paid.

In this experiment eighteen pigs, weighing about 140 pounds each, were divided into six lots, three in a lot.

The following rations were fed:

Lot 1. Milk, cornmeal, and pumpkins, cooked.

Lot 2. Milk, cornmeal, and pumpkins, uncooked.

Lot 3. Milk and pumpkins, raw.

Lot 4. Milk and cornmeal.

Lot 5. Milk, and pumpkins and apples, half and half, cooked.

Lot 6. Milk, cornmeal and bran, half and half.

The gain in live weight and the average daily gain of each pig is shown in the following table:

TABLE I.

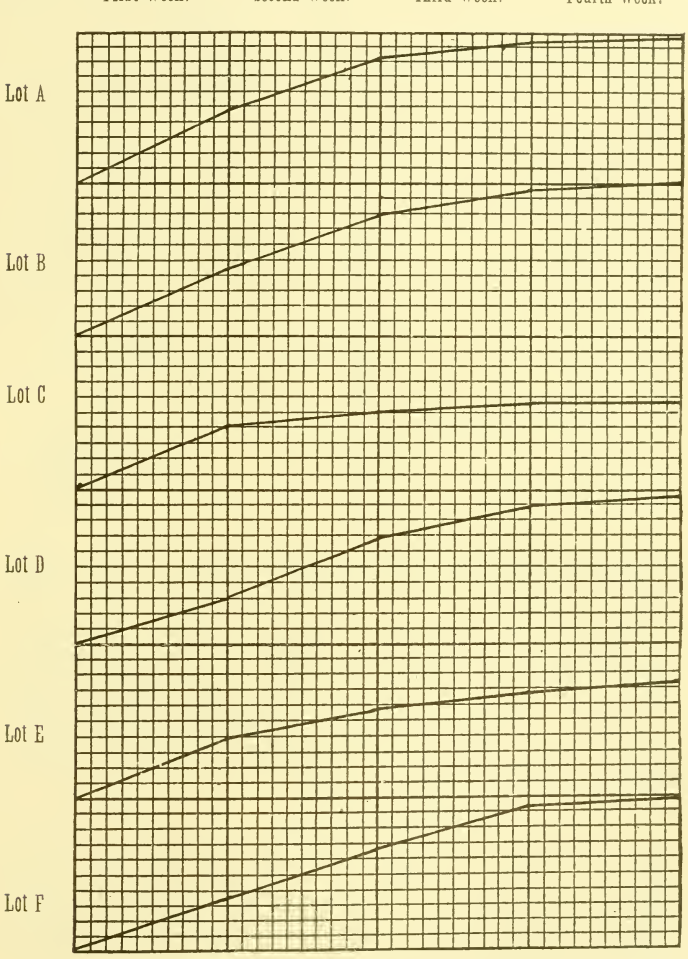
Gain in Live Weight by feeding Pumpkins, cooked and uncooked, Cornmeal, Cornmeal and Middlings, and Apples and Pumpkins.

Lot and Kind of Feed.	Weight at beginning.	Weight at ending.	Gain.	No. days.	Average lbs. gained per day.
Lot A. Milk, Cornmeal, Pumpkins (cooked)	416	582	166	25	2.21
Lot B. Milk, Cornmeal, Pumpkins (uncooked)	426	596	170	25	2.26
Lot C. Milk, Pumpkins (uncooked)	423	507	84	25	1.12
Lot D. Milk, Cornmeal,	418	566	148	25	1.97
Lot E. Milk, Pumpkins, Apples,	420	536	116	25	1.54
Lot F. Milk, Corn, Bran,	428	590	162	25	2.16

It will be noted that the greatest gain was made by the lots having cornmeal as a part of the ration, the pumpkin-fed lot being in the lead. The least gain was made by the lot receiving only milk and raw pumpkins. The table shows there was a range in daily gain from 1.12 pounds in the lot fed raw pumpkins to 2.26 pounds in the lot receiving cornmeal in connection with raw pumpkins. We also see there was

but little difference in lot gain and average daily gain where pumpkins were fed cooked or raw.

The chart below shows the weekly gains and variations in gain for each lot for the whole period:



A clearer idea of the feeding values of these rations is given in the next table.

TABLE II.

Comparative value of Pumpkins, cooked and raw, Cornmeal, Pumpkins and Apples, Bran and Cornmeal, with equal amount of milk in pig feeding.

Lot and Kind of Feed.	Days fed.	Feed eaten.				Gain.	Feed for 100 lbs. gain.			
		Milk.	Grain.	Pumpkins.	Apples and pumpkins.		Milk.	Grain.	Pumpkins.	Pumpkins and apples.
Lot A. Milk, Cornmeal, Cooked pumpkins,	25	630	514	742	.....	166	379	309	447	.....
Lot B. Milk, Cornmeal, Raw pumpkins,	25	630	514	1,348	.....	170	370	302	793	.....
Lot C. Milk, Raw pumpkins,	25	630	.....	3,798	.....	84	750	.....	4,520	.....
Lot D. Milk, Cornmeal,	25	630	549	.....	.....	148	492	377	.....	.....
Lot E. Milk, Apples cooked, Pumpkins cooked,	25	630	.....	.....	3,762	116	545	.....	.....	3,246
Lot F. Milk, Bran, Cornmeal,	25	630	636	.....	.....	162	388	392	.....	.....

The same amount of milk was fed to all the lots. The pumpkin-cornmeal lots also were fed an equal amount of cornmeal. In the four pumpkin-fed lots, the pigs were allowed all the pumpkins they would eat. The reader will observe that much less of the cooked ration was eaten. However, where no cornmeal was fed there was a much larger amount eaten to furnish a sufficient amount of digestible nutrients. By further examining the table we see that for gain of each lot there was a considerable difference in necessary amount of food to produce 100 pounds gain.

COST OF FOOD.

The cornmeal was bought at $16 per ton and $17 per ton was paid for the bran. The skim-milk fed was from our own dairy and has been considered worth 20 cents per hundred pounds. The pumpkins were raised at this station at a cost of 40 cents per ton, and the apples were charged at the rate of 10 cents per bushel.

Going now to the next table we see the financial results from feeding the six lots.

TABLE III.

FINANCIAL SUMMARY IN FEEDING TO PIGS

Pumpkins, cooked and uncooked; apples and pumpkins; cornmeal; and cornmeal and bran.

Lot.	Kind of Feed.	Amount of feed eaten.	Cost of food.	Market value of gain at 5½ cts. per pound.	Profit.	Cost per pound gain.
A.	Milk	630	5.52	9.13	3.61	$0.0332
	Cornmeal	514				
	Cooked pumpkins	742				
B.	Milk	630	5.64	9 35	3.71	.0331
	Cornmeal	514				
	Raw pumpkins	1,348				
C.	Milk	630	2.01	4.62	2.62	.0239
	Raw pumpkins	3,798				
D.	Milk	630	5.65	8.14	2.49	.0381
	Cornmeal	549				
E.	Milk	630	5.39	6.38	.99	.0464
	Pumpkins	1,881				
	Apples	1,881				
F.	Milk	630	6.51	8.91	2.40	.0401
	Cornmeal	318				
	Bran	318				

Value of feeds — Milk, 20 cents per 100 lbs.; pumpkins, 40 cents per ton; apples, 10 cents per bushel; cornmeal, $16 per ton; bran, $17 per ton.

It will be noticed from this table that the lots fed cornmeal wholly, or in part, had the highest market value, but it should be borne in mind that the cost of food was greater, hence highest profit does not necessarily follow.

Again, the highest market value was from the lot fed raw pumpkins and cornmeal. Close to this lot in value are the lots fed cooked pumpkins and cornmeal; cornmeal, and cornmeal and bran. There was but little difference in the cost of the food for these lots, the cornmeal-bran ration being the highest.

The lot fed raw pumpkins and milk brought in the least money, but the cost of the food was less by half than any of the other lots. Estimating the cost for each pound of gain we find the raw-pumpkin lot produced a pound of gain at a cost of only 2.39 cents, while all the other lots required over

3 cents' worth of food to produce one pound of gain, and the corn-bran ration cost over 4 cents per pound. The highest cost to produce a pound of gain was in the apple-pumpkin ration, where 4.64 cents of food was required to produce one pound of gain. This was due to the price of apples. The latter, even at the low price of 10 cents per bushel proved less economical as a food for feeding these pigs than any of the other rations, and where they were used in connection with pumpkins the average profit for the whole period was but 33 cents for each pig.

All things considered, the lots fed pumpkins, either raw or cooked, in connection with cornmeal, produced the greatest profit, and at least cost for each pound gain, live weight.

CONCLUSIONS FROM THIS EXPERIMENT.

1. The cooking of pumpkins does not increase their feeding value.
2. When pumpkins are available for pig feeding they can be fed most economically in connection with cornmeal.
3. While raw pumpkins fed in connection with milk produced a pound of gain at small cost, so few pounds were propuced it is advisable to feed cornmeal with them.
4. Apples, even at the low price of 10 cents per bushel, are not an economical food for pigs.
5. Bran is not desirable as a food for pigs, even if fed with cornmeal. This is further considered in the following experiment.

EXPERIMENT NO. II.

FEEDING VALUE OF BRAN, FERMENTED AND UNFERMENTED; BRAN AND CORNMEAL; CORNMEAL IN PIG FEEDING.

This experiment also was conducted with pigs raised at this station. The writer has been frequently told that some farmers in the state are in the habit of fermenting and souring bran before feeding it to their pigs, holding that the best gain is made by so doing.

With this in mind, the writer outlined the following experiment and fed four lots of pigs, three in a lot, for 120 days. The pigs used were from a cross between Chester white sows and Berkshire boar, and at the beginning of the experiment weighed from 45 to 50 pounds each.

The experiment was divided into two periods; the first for 99 days, and the second 21 days.

During the first period,—

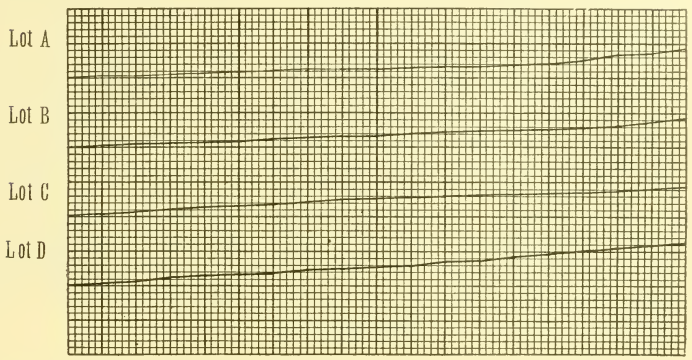
Lot A was fed fermented bran and milk.

Lot B was fed unfermented bran and milk.

Lot C was fed bran, cornmeal, and milk.

Lot D was fed cornmeal and milk.

At the end of the period all four lots were fed for 21 days on a ration consisting of milk and cornmeal. Each lot was weighed weekly during the two periods. The chart below marks the fluctuations of gain:



In fermenting the bran it was steamed in a barrel and left for 10 days before it was used. By this time it was quite sour and had undergone fermentation to some extent.

The table below gives the gain in live weight and the average daily gain during both periods:

TABLE IV.

Gain in live weight and average daily gain by periods.

Lot.	Ration—First Period.	Weight at beginning.	Weight at end.	Gain.	Number of days.	Daily gain.	Average daily gain.
A.	Fermented bran	141	321	181	99	1.83	.61
B.	Unfermented bran	144	352	208	99	2.10	.70
C.	Bran and cornmeal	143	370	227	99	2 29	.76
D.	Cornmeal	141	464	323	99	3.24	1.08
	SECOND PERIOD.						
A.	Cornmeal	321	412	91	21	4.33	1.44
B.	Cornmeal	352	430	78	21	3.71	1.24
C.	Cornmeal	370	426	56	21	2.66	.88
D.	Cornmeal	464	551	87	21	4.14	1.38

The table is full of interest. There is a gradual increase in weight from the fermented ration fed to Lot A to the cornmeal ration fed to Lot D. The average daily gain is greatest in the cornmeal-fed lot, where it is 1.08 pounds, while the fermented-bran ration shows an average daily gain of but .61 pounds; unfermented bran, .70 pounds, and bran-cornmeal ration, .76 pounds. This is quite decidedly in favor of the cornmeal ration.

When the second period was begun, the bran part of the rations was left off, and cornmeal was fed to all the lots. The bran-fed hogs, or Lots A and B, made a decided increase, and at the end of 21 days the fermented-bran fed hogs not only had made the greatest total gain, but the average daily gain increased from .61 pounds of the first period to 1.44 pounds in the second period. The other two lots, fed respectively cornmeal, and bran and cornmeal, made but little increase in average daily gain. The next table gives us the comparative values of each ration for the first period.

TABLE V.

Comparative value of Fermented Bran, Unfermented Bran, Bran and Cornmeal, and Cornmeal for Pig Feeding.

Lot and Kind of Feed.	Days fed.	Feed Eaten.		Gain.	Feed for 100 lbs. Gain.	
		Grain.	Milk.		Grain.	Milk.
Lot A, fermented bran	99	527	1740	181	291	906
Lot B, unfermented bran	99	668	1921	208	322	923
Lot C, cornmeal and bran, equal parts	99	699	2004	227	308	882
Lot D, cornmeal	99	852	2144	323	263	663

At the end of the 99 days cornmeal alone was fed with the following results:

TABLE VI.

Results obtained by Feeding Cornmeal to above Lots to End of Experiment.

Lot.	Days fed.	FEED EATEN.		Gain.	FEED FOR 100 LBS. GAIN.	
		Grain.	Milk.		Grain.	Milk.
Lot A.	21	300	556	91	329	720
Lot B.	21	251	588	78	321	753
Lot C	21	229	616	56	409	1,100
Lot D.	21	314	783	87	372	900

In the next table the comparative values of the four rations for the two periods have been combined, giving us the results for the whole period.

TABLE VII.

Results obtained in feeding during whole period.

Lot.	No. of Days.	FEED EATEN.		Gain.	FEED FOR 100 LBS. GAIN.	
		Grain.	Milk.		Grain.	Milk.
Lot A	120	827	2396	272	304	881
Lot B	120	919	2309	286	321	872
Lot C	120	928	2620	283	327	926
Lot D	120	1166	2827	410	284	689

It is of interest to note that the cornmeal-bran lot consumed the greatest amount of food for each 100 pounds gain, followed in order by the unfermented-bran and fermented-bran lots. The cornmeal lot produced not only the greatest gain, but at the least consumption of food.

COST OF FEED.

The same prices were paid for the feed as in the previous experiment. The table following gives the financial summary for the two periods.

TABLE VIII.

Financial Summary for the Two Periods.

Lot and Kind of Feed.	Total gain.	Total cost of feed.	Cost per pound of gain for whole period.	Market value of gain at 5½c.	Profit.
Lot A, First 99 days, fermented bran, Following 21 days, cornmeal,	272	$10.35	$0.0380	$14.96	$4.61
Lot B, First 99 days, unfermented bran, Following 21 days, cornmeal,	286	11.52	.0392	15.73	4.21
Lot C, First 99 days, bran and corn meal, equal parts, Following 21 days, cornmeal,	283	9.70	.0343	15.57	5.87
Lot D, Whole period of 120 days, corn meal,	410	13.61	.0332	22.55	8.94

It will be seen at once in consulting the table that the greatest market value was from the cornmeal-fed lot, as was also the greatest profit produced at the least cost per pound.

The bran-cornmeal lot was materially below this, but slightly in excess of the bran-fed lots.

It should be noted that the greater part of the gain for food consumed in the bran-fed lots was made during the second period, when cornmeal was fed as the only grain feed.

CONCLUSIONS FROM THIS EXPERIMENT.

1. There is but little gained in fermenting bran for pig-feeding.

2. Bran is undesirable as a feeding stuff for pigs, fed either alone or in combination with cornmeal.

EXPERIMENT NO. III.

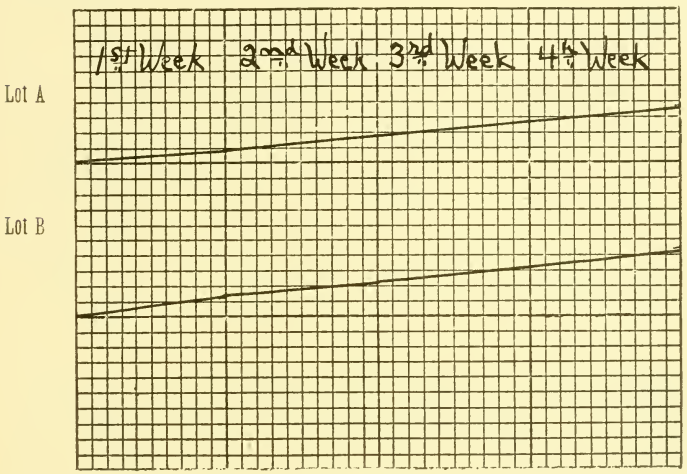
EAR CORN COMPARED WITH GROUND CORN AND COB FOR PIGS.

The practical question arises as to the economy of grinding corn for pig feeding. When we consider that millers charge eight cents per bushel for grinding and add to this the cost of hauling corn to and from the mill, the question becomes one of considerable importance.

This led us to divide the available corn we had into two equal quantities; one half was taken to the mill and ground, grain and cobs, the other half was reserved whole for feeding in comparison with that which was ground.

Six hogs, weighing about 50 pounds each, were divided in two as equal lots as could be made. They were the same kind as previously described. Lot A was fed corn in the ear; Lot B was fed ground corn and cob. Both lots were fed the same quantities of both milk and corn daily.

The chart below shows the weekly variations of gain during the four weeks that the experiment lasted. On account



of the limited amount of grain on hand, the experiment could be conducted for only four weeks. The table below gives the gain for the period and the average daily gain for each pig.

TABLE IX.

Feeding value of Corn on Cob and Corn and Cob Ground in Pig Feeding.

Lot and Feed.	Weight at beginning.	Weight at end.	Gain.	No. of days.	Average daily gain.
Lot A, corn in ear	152	220	68	28	.81
Lot B, ground corn	148	219	71	28	.87

In looking over the results we see there is but a slight margin in favor of the lot fed ground corn and cob. During the entire four weeks, with same food, differing only in the conditions fed, there was a difference of but 3 pounds for the whole period, and the difference in the average daily gain was but .06 pounds in favor of Lot B.

The next table shows the comparative value of the two methods.

TABLE X.

Ear Corn or Ground Corn and Cob in Pig Feeding.

Lot and Feed.	No. of days.	Feed Eaten.		Gain.	Feed for 100 lbs. Gain.	
		Milk.	Grain.		Milk.	Grain.
Lot A, corn on ear	28	607	227	68	892	333
Lot B, corn ground	28	607	227	71	855	319

It will be observed that the same amount of milk and corn was fed in both cases, with the result that the ear corn lot required 892 pounds of milk and 333 pounds of grain, as against 855 pounds of milk and 319 pounds of grain of the ground corn and cob to produce 100 pounds of gain—live weight. This is a difference of 14 pounds of corn, including the cob. At the rate of $16 per ton, the 14 pounds has a value of 11.2 cents.

Counting the cost of grinding a bushel of corn at eight cents, 100 pounds would cost 12 cents for grinding. The 14 pounds gained by grinding has therefore a less feeding value than the amount paid for grinding, and we have saved, at the same time, the expense and labor of hauling to and from the mill.

CONCLUSIONS FROM THIS EXPERIMENT.

1. Ground corn and cob has a slightly better feeding value than corn on the ear.

2. For practical purposes it is more economical to feed corn on the ear rather than hauling to the mill and grinding for feed.

Larva

THE SPINY ELM CATERPILLAR

Chrysalis

Bulletin 67

October, 1899

BY

Clarence M. Weed

NEW HAMPSHIRE
COLLEGE
AGRICULTURAL EXPERIMENT
STATION

Butterfly

DURHAM

Fig. 40. Spiny Elm Caterpillars at work.

THE SPINY ELM CATERPILLAR

BY CLARENCE M. WEED

In New Hampshire during the last three years there have been frequent complaints of injury to the foliage of elm trees by a black, spiny caterpillar. The extent of the injury appears to have been increasing from year to year until, in 1899, it attracted very general attention. In some localities the damage done was compared to that done by the hosts of the Forest Tent Caterpillar or Maple Worm. The correspondence of this station, as well as trips in the field, has shown the desirability of a full statement of the life history of the insect, and of the remedial measures to be taken against it.

Fig. 41. Mourning Cloak or Antiopa Butterfly.

This bulletin, therefore, is issued: it embodies a statement of the results of the studies of the insect carried on at this station by the entomologist and his assistant, Mr. W. F. Fiske, as well as a summary of the previous knowledge of the species. It aims, in short, to place before the people of the state a brief account of all that is known of the pest in so far as it may be of practical value.

THE LIFE HISTORY OF THE CATERPILLAR

During sunny days in spring one may often see a beautiful purple-black butterfly, having a cream-colored border along the outer margin of its wings, flying leisurely about. This butterfly is called the Mourning Cloak or Antiopa Butterfly; it is represented nearly natural size in Fig. 41. It has passed the winter in this adult condition, having found shelter in some retreat where it was not directly exposed to the storm and stress of the weather.

Fig. 42. Butterfly just after depositing eggs (*a*).

When the leaves of elm, willow, and poplar trees are nearly expanded these butterflies deposit their eggs upon the twigs. These eggs are laid in clusters encircling the twig, there being twenty or more in each cluster; their general appearance is shown in Fig. 42. In the act of oviposition the butterfly keeps her wings spread out, moving the body and abdomen about as the placing of the eggs necessitates. About two weeks after the clusters of eggs are thus laid upon the twigs of the food-plant they hatch into small blackish caterpillars, each emerging from the egg-shell through a small hole that it eats out of the upper surface. They thus enter upon the second stage of

their life-history—the larva or caterpillar stage. As soon as hatched they crawl to the nearest leaf, upon which they range themselves side by side, with their heads toward the margin of the leaf. They feed in this position, nibbling at the green surface of the leaf-blade, and leaving the network of veins untouched.

Fig. 43. Denuded twigs showing cast skins of the caterpillars.

These caterpillars continue to feed in this manner for about a week, remaining side by side when feeding, and marching in processions from one leaf to another, as the food supply is exhausted. Wherever they go each spins a silken thread on the surface traversed, so that the combination of all the threads makes a sort of carpet that serves as a foothold for

the caterpillars. At the end of the week they moult or cast their skins, a process in which the skin of each insect splits open along the back, and the caterpillar crawls out of it, being covered with a new skin that had been formed beneath the old one. This new skin stretches somewhat after the caterpillar emerges, so that the insect is able to increase con-

Fig. 44. Colony of Caterpillars feeding upon willow.

siderably in size. At the period of moulting the caterpillars remain quiet for a short time, but they soon become active again and begin feeding with increased voracity.

During the next three weeks this moulting process is repeated three times, the caterpillars becoming larger each time, and leaving their cast skins upon the denuded twigs, as shown in Fig. 43. They soon scatter more or less over neighboring

leaves, but remain in closely associated colonies, as represented in Fig. 44. As they increase in size they eat more and more of the leaf substance; when half grown they devour all but the midrib and the side veins, but when they get larger only the midribs are left, as may be seen in Fig. 43.

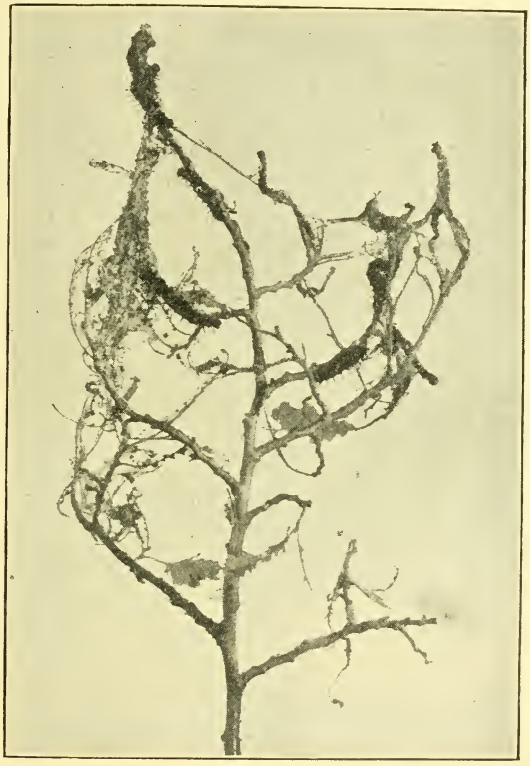


Fig. 45. Denuded Elm twig showing carpet web.

The carpet-web that they form becomes more conspicuous as the caterpillars develop, and often binds the ends of neighboring twigs together, especially in those places to which the caterpillars retire for rest after feeding. Examples of such webbing of the denuded surface are shown in Figs. 45 and 50.

About four weeks from the time of hatching these Spiny Elm Caterpillars become full grown. They then leave the tree or shrub on which they have been feeding and scatter about, seeking some sheltered situation. Having found this,—perhaps beneath a stump or along the underside of a fence,—each caterpillar spins a web of silk along the surface. It then entangles the hooked claws of its hind legs in this silken web and lets its body hang vertically with the head end curved upward. It remains in this position for some hours before the skin along the back just behind the head splits apart and is gradually wriggled upward until it is finally all removed, and there hangs in place of the caterpillar a peculiar object having no definite form. But it rapidly assumes a definite form—that of the chrysalis which is represented in Fig. 46. These pictures will show sufficiently the shape and size of the chrysalis, which is of a grayish brown color, different specimens varying somewhat in shade.

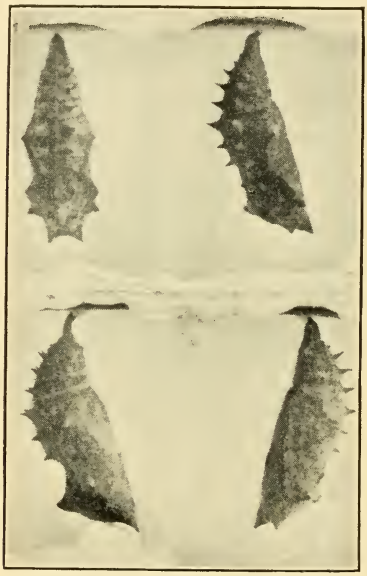


Fig. 46. Four views of the chrysalis. Natural size.

In this quiet chrysalis the insect is apparently almost as inert as a mummy. If you touch it, it will wriggle a little but otherwise it hangs there mute and helpless. On the inside, however, the tissues are being made over in such a wonderful way that in about two weeks, from the mummy-case into which the caterpillar entered, there comes a beautiful butterfly. When it first breaks the mummy-shell its wings

are very small, although its body, "feelers," and legs are well developed. By means of the latter it clings to the empty chrysalis while its wings expand. A butterfly in this position with its wings nearly expanded, is shown in Fig. 47, which like all but one of the photographs of the insects illustrated in this bulletin was taken from the living specimen. In the course of half an hour the wings become fully developed, and the butterfly is likely to crawl to some firmer support where it will rest an hour or so before venturing upon its first flight.

FOOD-PLANTS OF THE CATERPILLARS

The caterpillars of the Mourning Cloak Butterfly are restricted to comparatively few food-plants. In regions where they are not especially abundant they are likely to be found upon willow, poplar, or elm. In general our observations indicate that they are as likely to be found on any one of these food-plants as upon either of the other two; but in certain localities where they become especially abundant it seems that they are more likely to occur upon the elm. There is considerable evidence to show that they prefer the American elm to other species of the genus, although in the case of willow and poplar there seems to be little if any preference as to species. Miss C. G. Soule has seen the butterflies depositing their eggs upon the white and canoe birch, and in Labrador and Europe it has been recorded as feeding upon a species of birch. There is one record of the caterpillars having been found feeding upon the hackberry (*Celtis occidentalis*), and

Fig. 47. Butterfly hanging to empty chrysalis as its wings expand.

also one of their having fed greedily upon the leaves of rose, and another of their having almost defoliated a pear tree. Linden and nettle are also included in the European lists of the food-plants of this species. It is evident, however, that all of these except the three first named—willow, poplar, and elm—are to be regarded as exceptional cases, and that the normal food of the species is the foliage of a plant belonging to one of these three genera.

BROODS AND HIBERNATION

It has generally been supposed that this species is double-brooded in central and southern New England, the butterflies of the first brood appearing early in July. These are said to deposit eggs which hatch into caterpillars that mature into butterflies early in September. These butterflies live through the winter, laying eggs the following spring.

Unless the summer of 1899 was exceptional, however, this idea of the yearly history of the species will have to be modified, for during this season, in New Hampshire and Vermont at least, there was practically but one brood. Continual observations by Miss Caroline G. Soule at Brandon, Vt., and by Mr. Fiske and myself in this state show that there was scarcely a trace of a second brood of caterpillars, for with all our searching in July and August we found but a single colony of larvæ. These were discovered on a willow at Durham August 3. During the period when the second brood of caterpillars are supposed to be at work, I traveled by carriage and on foot over hundreds of miles of roadway in southern New Hampshire and southern Maine, and though there was everywhere evidence of the presence of the first brood, none of the second were seen. During the same period Miss Soule was watching in the region of Brandon, Vt., and Mr. Fiske took an extended trip through central New Hampshire. But save for the single colony mentioned, all our looking did not reveal a trace of the second brood. Nor was there a single complaint from correspondents of injury at the supposed time of the second brood, although many accounts of the depredations of the first brood were received.

In view of all this evidence it seems safe to conclude that in the region under consideration a single brood is the rule rather than the exception. This involves the conclusion that the butterflies seen upon the wing early in autumn are the same ones that developed in July, and that these same butterflies remain alive through the winter and until, in the following May, they lay their eggs. Thus there is a period of ten months of existence in the butterfly state, an extraordinary length of time for a butterfly to live.

To a large extent the butterflies disappear in August, and the question arises as to what becomes of them. Our observations lead to the conclusion that they go into summer quarters similar to those which they seek out for winter shelter. Apparently they fly about for a few days after coming from the chrysalis and then retire to cool woods, where under the side of a log or beneath the loose bark of a dead tree they settle down and to all appearances go to sleep. The instinct to remain quiet is very strong in these butterflies. In making the photographs that illustrate this bulletin I found that even shortly after coming from the chrysalis the butterflies when disturbed would fold their wings with the antennæ between them, and drawing the legs against the body, would lie quietly on their sides for a long time; the position thus assumed by the living butterfly is shown in Fig. 48. These same butterflies would also hang downward from a limb by the hour in the hibernating position as shown in Fig. 49.

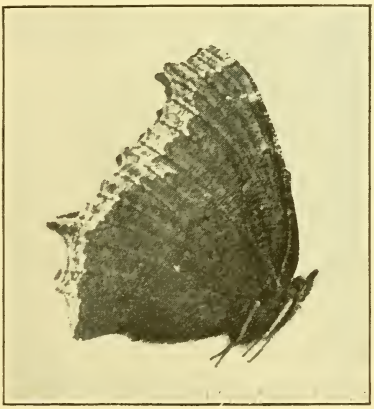


Fig. 48. Butterfly "playing 'possum".

In the cooler weather of early autumn the butterflies come from their summer retreats and fly about in the sunshine.

They are especially likely to be seen along the borders of woods or in open glades. At this time they love the sunshine, and will settle in a sunny place to bask in it.

On a spring-like day early in November (the eighth) I came across one of these butterflies basking in the sunshine upon the ties of a railway track. It rested with its wings wide open. On being disturbed it would fly a short distance and then alight, and I was interested to notice that after alighting it would always turn about until the hind end of its

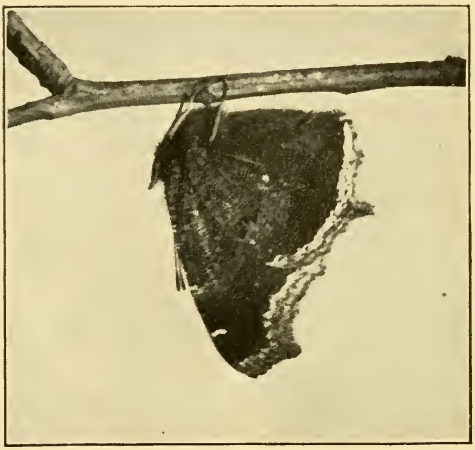


Fig. 49. Butterfly hanging from branch in hibernating position.

body pointed in the direction of the sun, so that the sun's rays struck its wings and body nearly at right angles. I repeatedly observed this habit of getting into the position in which the most benefit from the sunshine was received, and it is of interest as showing the extreme delicacy of perception toward the warmth of sunshine which these creatures possess.

During the colder part of the year in bright weather when these butterflies are most often abroad, they commonly hold their wings open when they alight, but during the warmer summer days they are more likely to rest with the wings closed.

When the warm days no longer tempt them abroad the Mourning Cloak Butterflies seek shelter in many sorts of situations,—under loose bark, in hollow trees, under culverts and bridges, in woodpiles, in crevices of rocks, alongside logs lying on the ground. In such retreats they remain until the sunshine of spring again calls them forth.

FEEDING HABITS OF THE BUTTERFLY

The Mourning Cloak Butterflies subsist upon a considerable variety of liquid food which they suck through their long tongues. In spring, when they first come from their winter quarters, they visit the stumps of recently cut trees and suck the exuding sap, a habit which they continue whenever opportunity offers. Mr. Fiske has noticed that they commonly sip the sap of maple twigs where the squirrels have gnawed the bark. A little later they visit the willow catkins to suck the nectar secreted by these blossoms, and still later they hover about the delicate blossoms of the mayflower or trailing arbutus for a similar purpose. Probably many other flowers are thus rifled of their sweets, although this butterfly seems to be a less regular visitor to flowers than are many of its allies. A little later, when the aphides or plant-lice have become sufficiently abundant so that the so-called "honey-dew" is to be found upon the infested shrubs, these Mourning Cloaks sometimes sip the liquid sweet from the surface of the leaves. In April and May they occasionally visit the flowers of moosewood, and later in the season have been observed upon the blossoms of the common milkweed. From the time the early apples ripen these butterflies may often be seen beneath the orchard trees sipping the liquids of the fallen and decaying fruit.

POPULAR NAMES OF THE BUTTERFLY

In Germany this butterfly is called *Trauermantel*, from the translation of which is derived the common American name, Mourning Cloak. Its other common name with us, Antiopa Butterfly, is derived from its Latin name,—*Vanessa antiopa*.

In England it is called the Camberwell Beauty, from its having been found at an early date at or near Camberwell. A still earlier title adopted for it in England was "The Grand Surprise," given by butterfly collectors because at the beginning of the century after a long absence it appeared in considerable numbers.

In most books upon insects the technical name of this butterfly is given as *Vanessa antiopa*. In his recent writings Mr. S. H. Scudder has called it *Euvanessa antiopa*, although in one of his earlier books he called it *Papilio antiopa*. Questions of nomenclature, however, need no consideration in this connection, and I mention these names only for the guidance of any reader that may wish to study what has been printed about the species.

THE CATERPILLARS NOT POISONOUS

During the earlier years of our country's history many people regarded these caterpillars as "venomous and capable of inflicting dangerous wounds." Dr. T. W. Harris states that he had known people to cut down poplar trees around dwellings to prevent the presence of such dangerous caterpillars. But these insects are not poisonous, and may be handled with little fear of injury, although the sharp spines might perhaps penetrate the delicate skin of a child's hand.

GEOGRAPHICAL DISTRIBUTION

The Mourning Cloak Butterfly is one of the most widely distributed insects in existence. Not only is it found in North America as far south as Bermuda, Florida, and Mexico, but it is also found throughout northern Europe, and in Asia and Japan. Consequently, as Mr. Scudder has said, it appears to be distributed "over the entire breadth of the northern hemisphere, below the Arctic circle as far south as the thirtieth parallel of latitude." This is an extraordinary distribution for an insect, and shows a remarkable power of adaptation to the varying surroundings in which the species occurs. In the northern United States this is one of the commonest and most familiar butterflies.

ABUNDANCE AND INJURIES

As a rule the caterpillars of the Mourning Cloak Butterflies are to be found only in occasional colonies, so that the damage they do attracts little if any attention. But sometimes the weather or other conditions are so favorable to their

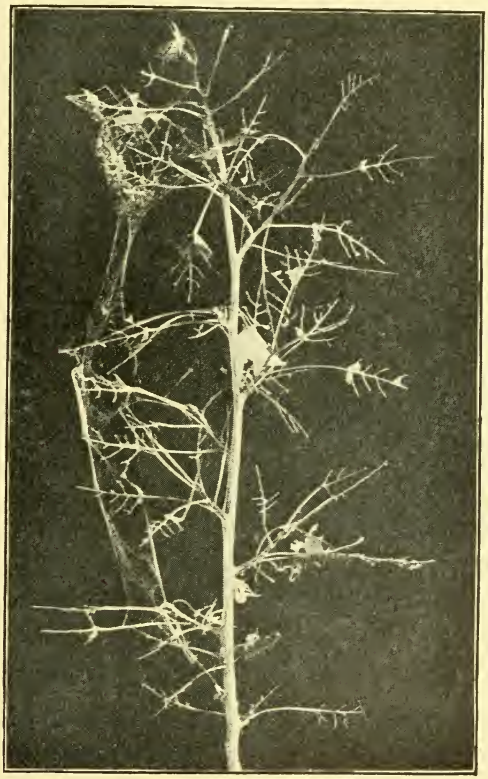


Fig. 50. Poplar twig denuded by caterpillars, showing carpet web.

development that they multiply beyond this normal limit and are to be found in great numbers. At such times serious damage is often done. In this country such local outbreaks of the species have frequently occurred, generally, however, over very limited areas. So far as I can learn the insect has

never caused such widespread destruction as the Forest Tent Caterpillar has recently caused in New England. In the tree plantations of the prairie regions of the West, these caterpillars are, according to Prof. Otto Lugger, "very injurious and sometimes denude whole rows of willows and poplars." The same observer adds: "They are still more fond of the leaves of elms, and I have seen them so numerous upon those trees in Michigan that branches were broken by their weight." In other regions of the West similar records have been made.

NATURAL ENEMIES

Like most other insects the Mourning Cloak Butterflies have many natural enemies to contend against. From the moment the egg is laid until the butterfly dies it is in constant danger.

Some of the eggs never hatch into caterpillars because a tiny fly, scarcely one twentieth of an inch in length, finds the egg mass, and deposits in each egg another egg,—the latter being microscopic in size. This tiny egg soon hatches into a maggot almost equally tiny, and the maggot grows by absorbing the contents of the butterfly egg. In due time it changes to a minute pupa, later to change to a minute fly like the one that laid the microscopic egg. This minute fly now gnaws a hole through the egg-shell of the butterfly and comes out into the world. The little creature that has thus developed at the expense of the egg of the butterfly is called an egg parasite. There are many species of these egg parasites and they attack the eggs of many kinds of insects. The particular species that develops in the eggs of the Mourning Cloak Butterfly is called by scientists *Telenomus graphæ*.

After hatching from the egg the caterpillars are subject to the attacks of various parasites. One of these is quite minute,—not a great deal larger than the egg parasites. It is a tiny four-winged fly which deposits many eggs in a single caterpillar. The eggs hatch into tiny maggots that grow at the expense of the caterpillar, finally killing it and changing to four-winged flies again. As many as 145 of these para-

sites have been known to emerge from a single dead caterpillar. These little flies are called *Chalcids* by entomologists.

There is still another group of four-winged flies, some of which attack the Antiopa Caterpillars. These are much larger than the Chalcid flies and are called *Ichneumon Flies.* In the case of these only one or two parasites develop in each caterpillar or chrysalis.

In addition to these various four-winged flies there are certain two-winged flies, called *Tachinid Flies*, that develop at the expense of the caterpillars. In New Hampshire, during recent years, these appear to have been the most abundant parasites of these insects. An egg is laid on the skin of the caterpillar by a two-winged fly, similar in general appearance to Fig. 51. The contents of this egg shortly develop into a tiny grub that burrows through the egg-shell and the skin of the caterpillar into the inside of the body. Here it remains absorbing the body substance of its host and gradually increasing in size. In a few weeks it becomes fully developed in this grub state. By this time the caterpillar has become sluggish from the effects of the parasite. If the branch upon which it feeds is disturbed the other caterpillars are likely to crawl away, but it remains in its place. The caterpillars illustrated on the web in Fig. 45 were parasited specimens that thus remained after the others had crawled away.

Fig. 51. Tachinid fly. (Redrawn from Scudder.)

Shortly after becoming full grown the Tachinid grub breaks through the skin of the dying caterpillar and falling to the ground changes to a peculiar pupa; the outer skin of the grub turns brown and becomes hard, forming a protective covering for the body inside. A week or two later the insect undergoes another change and emerges as a two-winged Tachinid fly like the one that laid the egg some weeks before.

Our observations indicate that during the last season a comparatively small proportion of the caterpillars were affected by parasites of any kind.

PREDACEOUS INSECTS

Besides those insects which develop on the inside of the bodies of these caterpillars, called parasites, there are other insect enemies that attack them from the outside and devour them bodily. Such enemies are called predaceous insects. The most notable of these, perhaps, is a large beetle called the caterpillar hunter; it is known to entomologists as *Calosoma scrutator*. Some cases are on record in which this insect has been observed to destroy many of the Antiopa Caterpillars. In New Hampshire, however, this beetle is comparatively rare, and it can be relied upon for but little help.

In the Southern states a large reddish wasp has been observed to attack and destroy the Antiopa Caterpillars. There are probably also various other insect enemies at work, although definite observations upon them have not been recorded.

These Elm Caterpillars are such spiny creatures that comparatively few birds attack them. They are devoured, however, by the cuckoos, of which we have two species in New England,—the yellow-billed and the black-billed cuckoos. It is probable also that these insects are eaten by Baltimore orioles and various other birds.

These caterpillars are also greedily devoured by toads, but of course as a rule they do not come within reach of these useful animals.

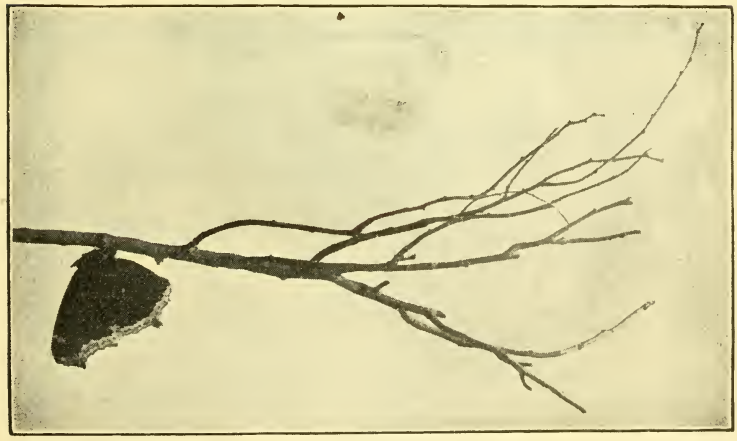
REMEDIES

In general the most satisfactory remedy for these caterpillars is to cut off while they are still young the branch on which they are feeding, and crush or burn the insects. After they become larger they may be shaken off and crushed. Or the colonies may be brought down with a torch, care being taken to kill the caterpillars that fall to the ground, as probably many of them will not be seriously injured by the flame. Jarring the limbs with a padded mallet will also be a useful way of bringing down those out of reach; or they may be brought down by use of a strong stream of water from a force pump or hydrant.

These caterpillars are also open to destruction through spraying with arsenate of lead or other forms of arsenical poisons.

BANDING THE TREES IS USELESS FOR THESE CATERPILLARS

In one city in this state where the Spiny Elm Caterpillars were rather abundant last season, many owners of shade trees applied bands of various sorts to the trunks of the trees to prevent the injury. Presumably this was done on the theory that as bands are successfully employed against canker worms, they are equally good against other caterpillars. In the case of canker worms, however, the female moth which lays the eggs is wingless, so that the bands prevent her from ascending the trees. But with the Spiny Elm Caterpillar the parent insect that lays the eggs is a butterfly which can easily fly to the tops of the tallest trees. The eggs are deposited on the twigs by these butterflies, and the caterpillars remain in the close neighborhood of the place where they hatch until they are full grown. Consequently, any banding of the tree is a waste of energy so far as this insect is concerned.



Bulletin 68. November, 1899.

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

ELEVENTH ANNUAL REPORT

BY CHARLES S. MURKLAND

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS
DURHAM

NEW HAMPSHIRE COLLEGE

OF

AGRICULTURE AND THE MECHANIC ARTS

AGRICULTURAL EXPERIMENT STATION

DURHAM, N. H.

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ELEVENTH ANNUAL REPORT

The eleventh annual report of the New Hampshire College Agricultural Experiment Station, for the year ending October 31, 1899, is herewith respectfully submitted. The reports of the department will be found upon the pages indicated in the following list:

Financial statement 145
Report of the Vice-Director 147
Department of Horticulture 151
Department of Agriculture 154
Department of Entomology 157
Department of Bacteriology 158
Department of Meteorology 164

CHARLES S. MURKLAND,
Acting Director.

ANNUAL STATEMENT

Of the Hatch Fund of the New Hampshire College of Agriculture and the Mechanic Arts, for the year ending June 30, 1899.

RECEIPTS

Cash received from United States treasurer . .	$15,000.00

EXPENDITURES

Cash paid for salaries	$7,920.91
labor	1,605.51
publications . . .	2,368.74
postage and stationery .	85.02
freight and express .	109.00
heat, light, and water .	979.81
chemical supplies . .	126.35

Cash paid for seeds, plants, and sundry supplies	$132.36	
fertilizers	150.00	
feeding stuffs	101.00	
library	299.71	
tools, implements, and machinery	8.63	
furniture and fixtures	131.63	
scientific apparatus	707.46	
traveling expenses	60.11	
contingent expenses	5.80	
building and repairs	207.96	
		$15,000.00

SUPPLEMENTARY STATEMENT

Receipts

Balance on hand	$340.55
Cash received from the State Board of Agriculture for analysis of fertilizers	656.25
	$996.80

Expenditures

Cash paid for salaries	$551.57	
Cash paid for feeding stuffs	21.85	
Balance	423.38	
		$996.80

We, the undersigned, duly authorized auditors of the corporation, do hereby certify that we have examined the books and accounts of the New Hampshire College Experiment Station for the fiscal year ending June 30, 1899; that we have found the same well kept and classified as above, and that the receipts for the year from the treasurer of the United States are shown to have been $15,000, and the corresponding disbursements $15,000; for all of which proper vouchers are on file and have been by us examined and found correct.

Also, that the recepits from fertilizer analyses have been duly expended and vouched for, as per supplementary statement.

And we further certify that the expenditures have been solely for the purposes set forth in the act of congress approved March 2, 1887.

(Signed)
JOHN G. TALLANT,
CHARLES S. MURKLAND,
Auditors.

Durham, N. H.

REPORT OF THE VICE-DIRECTOR

To Charles S. Murkland, Acting Director:

The different lines of work of the Agricultural Experiment Station and the progress made in them for the year ending October 31, 1899, are described in the reports from the different departments.

Nine bulletins have been issued during the year, including this annual report, namely,—

No. 60. Green Corn under Glass. By F. Wm. Rane.

No. 61. Inspection of Fertilizers in 1898. By Fred W. Morse.

No. 62. Forcing Pole Beans under Glass. By F. Wm. Rane.

No. 63. Third Potato Report. By F. Wm. Rane.

No. 64. The Forest Tent Caterpillar. By Clarence M. Weed.

No. 65. Notes on Apple and Potato Diseases. By Herbert H. Lamson.

No. 66. Experiments in Pig Feeding. By Charles Wm. Burkett.

No. 67. The Spiny Elm Caterpillar. By Clarence M. Weed.

No. 68. Eleventh Annual Report.

With the co-operation of the postmasters the list of persons in the state to whom bulletins are sent has been revised and enlarged, and it now includes nearly 7,000 names distributed among nearly all the postoffices in the state.

Changes and additions to the staff have been as follows:

APPOINTMENTS

Frederick S. Johnston, Associate Agriculturist. July.
Clarence W. Waid, Assistant Horticulturist. April.
Harry A. Clark, Assistant Chemist. August.
Roscoe H. Shaw, Assistant Chemist. October.
Harry P. Richardson, Assistant Agriculturist. October.
Frederick C. Keith, Clerk. August.

RESIGNATIONS

Clement S. Morris, Clerk. August.
Arthur Given, Assistant Chemist. September.
Harry E. Barnard, Assistant Chemist. September.
Elwin H. Forristall, Assistant Agriculturist. September.

Mr. Given has entered the employ of the American Steel and Wire Company at Worcester, Mass.; Mr. Barnard is assistant in the research laboratory of Dr. Wolcott Gibbs, Newport, R. I.; and Mr. Forristall is superintendent of the farm and dairy of the Walker-Gordon Company of Boston.

The following permanent improvements in buildings and fields have been made:

Storeroom in the basement of Nesmith Hall; birch floors in the bacteriological laboratories; division, by a plaster partition, of the large office in Nesmith Hall, into offices for the departments of horticulture and agriculture respectively; division of the large forcing house into three equal apartments; installation of Johnson's automatic system for regulating the temperature of the greenhouses; straightening and sloping the banks of the brook running through the experiment field.

Valuable additions have been made to the scientific apparatus, which include a Robert's dynamometer with lever and planimeter; a Bausch and Lomb microscope with continental

stand, triple nose-piece, three objectives, complete sub-stage attachment, and attachable mechanical stage; an Abbe's oleo-refractometer with heating attachment; and fifty sets of electrodes for soil-moisture measurements.

Additional insect cases and bookshelves have been built, and the files of bulletins and periodicals have been bound as far as practicable, up to the current year.

Department of Chemistry

The experimental investigations of the department of chemistry have been confined to studies of silage, apples, and potatoes. An unusually large amount of work has been done for the state board of agriculture, and the usual number of miscellaneous samples have been analyzed for the public.

Ninety-seven brands of fertilizers were analyzed for the board of agriculture as a part of the annual inspection of commercial fertilizers, and the results will be published in a bulletin in January next. The department also assisted the board in enforcing the oleomargarine laws, and examined, in the course of the work, 282 samples of butter and oleomargarine.

Of the miscellaneous analyses made for individuals, the following have been selected for publication in this report:

City Stable Manure

A sample of city stable manure was sent to the station, April 25, from Concord, by Hon. J. B. Walker, president of the board of agriculture. The sample measured one cubic foot in volume, weighed 38½ pounds at the laboratory, and was considered to represent an average lot of manure of its class.

The analysis of the sample gave the following results in percentage composition, and in pounds of fertilizing constituents per ton, and per cord weighing approximately 2½ tons.

	Per ct.	Lbs. per ton.	Lbs. per cord
Water	70.00	1,400.0	3,500.0
Organic matter . . .	20.70	414.0	1,035.0
Nitrogen, total . . .	0.69	13.8	34.5

Phosphoric acid, total . .	0.53	10.6	26.5
Potash, total	1.03	20.6	51.5
Potash, soluble in water . .	0.43	8.6	21.5

Spring Water

Since the publication of Bulletin No. 53, "The Farm Water Supply," some noteworthy results have been obtained from several unpolluted springs in different sections of the state, still further showing that our natural ground-waters are exceptionally pure and soft, and that water containing much chlorine and soluble salts must be regarded with suspicion and used with care.

	Composition.	Parts in 100,000 of water.	
Locality.	Chlorine.	Total solids.	Fixed solids.
Chester	0.30	2.90	1.45
Dover	0.35	2.00	...
Holderness	0.10	4.90	2.70
Keene	0.05	4.90	3.80
Temple	0.10	3.60	1.40
Whitefield	0.05	2.80	...

The water from Whitefield yielded a spectroscopic test for lithia in the solid residue; but it was not present in larger quantity than a distinct trace.

Wood Ashes

Three years ago Bulletin No. 43, "Some Inferior Wood Ashes," called attention to the fact that partially leached ashes were being sold in the state. Since that time we have received twenty-nine samples of ashes, of which nine were sent to the station in 1897, eleven in 1898, and nine this year.

Of these samples, but two showed evidences of having been leached. One of these was received last year and yielded only 2.38 per cent water-soluble potash and 3.82 per cent total potash. The other was received this fall and contained 1.67 per cent water-soluble potash and 1.94 per cent total potash.

The results obtained on all the samples are summarized as follows:

Phosphoric acid ranged from 1.01 per cent to 3.24 per cent. In twenty-two samples it was between 1.25 per cent and 1.75 per cent. Four samples gave results above 1.75 per cent, of which two were domestic ashes, with 2.65 per cent and 3.24 per cent respectively.

The potash soluble in water ranged from 1.67 per cent to 7.68 per cent. In fifteen samples it was between 4 per cent and 5 per cent; in seven samples between 5 and 6 per cent, and above 6 per cent in four. The total potash obtained by solution in hydrochloric acid ranged from 1.94 per cent to 10.15 per cent. In thirteen samples it was between 5 per cent and 6 per cent, in five between 6 and 7 per cent, and above 7 per cent in seven samples.

Respectfully submitted.

FRED W. MORSE,
Vice-Director and Chemist.

DEPARTMENT OF HORTICULTURE

The main lines of horticultural work at the station during the year have been with strawberries, muskmelons, tomatoes, grapes, and miscellaneous forcing crops under glass, reports upon which will be published in due time. Marked improvement has been made in our greenhouses. The old orchards have been placed under cultivation and preparations are being made for a larger planting of fruit trees the coming spring.

During the year three bulletins have been issued, viz., No. 60, "Green Corn under Glass"; No. 62, "Forcing Pole Beans under Glass," and No. 63, "Third Potato Report." If one may judge by the increased amount of correspondence, reports, and general conditions, the year has shown an increased interest in general horticulture throughout the state

Fruit Calendar for 1899

There have been comparatively few important matters to record for the past fruit season. Generally considered this

has been an off year, the extreme drouth of the early part of the season checking even the fruit that did set. Strawberries and other small fruits were more severely affected, perhaps, than the larger orchard fruits. Where it was possible to irrigate, or where the soil was of such a nature that it retained moisture, good crops were secured. Generally, however, they were cut very short. Not only was the crop small, but the season has been an exceptionally hard one in which to establish new plantations, and therefore a lack of similar fruit is liable to be felt next season.

It is generally considered that this has been the severest drouth we have had at this season of the year for the past generation. With our great variety of fruits, however, we find that what is harmful to one seems to favor another; the season was an ideal one for the grape. Reports from all sections go to show that not only was the crop very heavy but varieties which have heretofore been very indifferent, especially in ripening, matured this season and were exceptionally fine. The station vineyard, which is just coming into bearing, gave very fair returns, especially of the following varieties: Warden, Concord, Eaton, Early Ohio, Champion, Hartford, Ives' Seedling, Niagara, Brighton, Wyoming Red, Delaware, and Green Mountain. We anticipate giving a fuller report on the grape later.

The finest display seen this season in New Hampshire was the exhibit of Mr. J. E. Batchelder of Wilton, N. H., at Nashua. Mr. Batchelder exhibited at both the State Horticultural Society and the Nashua fair. His varieties were Moore's Early, Pocklington, Warden, Brighton, Cleveland, Salem, Niagara, Delaware, and Lindley. This exhibit was ideal throughout; fine, large, shouldered, and well-developed bunches containing large, well-colored berries characterized each plate. Grapes were plentiful and made a fine display at all of our fairs.

The orchard or tree fruits, especially the apple, varied more or less in different sections, some having practically none, while others produced a fair showing. Strange to say, even in the same section and orchard, a tree or part of a tree would

be heavily laden while others were barren. For this reason it has been a hard matter to estimate the season's returns. One tenth of a crop is perhaps a fair estimate for the apple crop. The writer observed when in Cheshire county this fall that every Blue Pearmain tree was loaded with fruit. It verily was a Pearmain year in this section; the fruit was large and perfect. Whether this observation holds true generally throughout the state is not known. This particular variety seems to be more commonly grown about Winchester than elsewhere. The only section reporting a full crop of apples was the southern portion of Carroll county.

Cherries were about as plentiful as usual. This fruit is sadly neglected generally, and the demand far exceeds the supply.

Pears were not plentiful but fairly supplied local demands at good prices.

Plums did not seem to be as abundant as usual, although a medium crop is reported generally. The largest yield was that of Mr. G. W. Parker of Wilton. Mr. Parker grew four hundred baskets, mostly of the Gueü variety. Damsons are, however, his best selling plums. He also fruited Burbanks, and is well pleased with them. The display of plums at the state grange fair was very good, the largest exhibitor being Mr. George F. Smith of Meredith. At the other fairs this exhibit was rather indifferent.

The peach crop we had thought a total failure until we found fair exhibits at Nashua and also at the Amesbury and Salisbury, Mass., fair. The display at Nashua was that of G. W. Parker of Wilton and consisted of excellent specimens of Oldmixon, Elberts, and Early Crawford. Mr. Parker tells me he had nearly one hundred baskets, which is a very small yield compared with that of last season. Last year he had upon two hundred Oldmixon trees alone eleven hundred baskets. The exhibit at the last named fair was that of Mr. Abraham Hilliard of Kensington, N. H. This display was also fine, consisting of two seedlings of marked value and the three varieties named above. Other peach growers report the

crop as a total failure. Mr. George Tuttle says that it was a difficult matter to find even a few to display this season. His is the orchard from which we reported over a thousand baskets last year.

While the fruit crop has been small, there nevertheless has seemed to be an awakening in fruit-growing which promises to result in a deeper interest. At the winter meeting of the state board of agriculture and the dairy convention held at the college last December, one day was set aside for discussing the growing of fruit. The summer meeting of the State Horticultural Society, known as "Strawberry day," which has grown in popularity the past few years, was well attended again this summer. The society and its friends met at the experiment station on June 29, under the auspices of the department of horticulture. Over one hundred varieties were displayed and partaken of, and after an informal meeting the visitors visited the strawberry patch, buildings, and grounds. The photograph, Fig. 53, shows a part of this gathering directly after lunch.

FRANK WM. RANE,
Horticulturist.

DEPARTMENT OF AGRICULTURE

During the past year the work of the department of agriculture has consisted of studies in an experimental way of some of the practical questions connected with agriculture.

Two divisions of work have been outlined: Animal Nutrition and Soil Physics.

In the first, the dairy herd, horses, and swine have been used in the studies. In the second, studies in soil improvement, soil moisture, physical treatment of soil, methods of applying manures, corn culture, clover culture, etc., have been made. These same lines of work will be continued during the coming year.

Fig. 53. "Strawberry day" at the Agricultural Experiment Station.

The College Herd

The college dairy herd at present consists of eighteen Jerseys, five pure-bred and thirteen grades, seven Ayrshires, three Guernseys, three grade Durhams, two grade Holsteins.

HERD RECORD FROM NOVEMBER 1, 1898, TO OCTOBER 31, 1899

Month.	Milch cows.	Dry cows.	Pounds of milk.	Average for each milch cow.	Average for herd.	Average fat test.	Pounds of butter.
November	25	7	10,603	424.1	27.3	4.6	575.33
December	27	5	13,141	486.7	33.8	4.5	696.93
January	25	8	14,719	588.7	37.9	4.9	824.26
February	30	2	14,400	480.0	37.1	4.5	756.88
March	28	5	15,155	541.2	39.0	4.8	866.38
April	27	6	13,654	505.7	35.1	4.7	748.54
May	28	5	14,852	530.4	38.2	4.2	727.74
June	25	7	13,549	561.7	34.9	4.7	724.08
July	27	5	13,957	516.5	35.9	4.5	725.47
August	24	8	14,124	588.5	36.1	4.0	659.27
September	28	4	14,152	505.4	36.4	4.6	759.48
October	29	3	14,422	497.3	37.1	4.8	800.21

The herd has been equivalent to 323 milch cows and 65 dry cows for one month, and has produced 166,728 pounds of milk and 8,864.57 pounds of butter, making an average monthly yield per head for 388 cows, 429 pounds of milk and 22.8 pounds of butter, or 5,148 pounds of milk and 273.6 pounds of butter for the year.

The data have been taken from the daily and weekly records of the barn and creamery, and the butter calculated by the standard formula, butter $= 1 + \frac{1}{6}$ fat, instead of the actual weights obtained, since the latter would involve corrections for milk and cream sold and fed to the calves.

Charles William Burkett,
Agriculturist.

DEPARTMENT OF ENTOMOLOGY

The work of the department of entomology during the year has followed closely along the lines of previous years. Realizing that the only way to obtain results of permanent value is to work continually and exhaustively upon the subjects selected for study, I have continued to confine our efforts to a comparatively few problems.

Two bulletins have been published by this department during the year. In April, Bulletin No. 64, treating of the Forest Tent Caterpillar, was issued to spread abroad a knowledge of this insect, which became exceedingly destructive in May and June. The October Bulletin (No. 67), treating of the Spiny Elm Caterpillar, was published to enlighten those interested concerning the life-history of, and remedies to be used against, this pest.

So much material has accumulated for the Insect Record of the year that it has been thought advisable to issue it as a separate bulletin rather than to incorporate it with this report, as has been done heretofore. A second bulletin upon the Forest caterpillar is also being prepared for publication this winter.

Studies of the life-history and parasites of both species of Tent Caterpillars have been continued through the season, as have the studies of several other injurious species, especially the Spiny Elm Caterpillar, the larva of the Mourning Cloak or Antiopa butterfly. With the assistance of Mr. Ned Dearborn, studies of the food of birds have also been continued, the species receiving special attention being the Ruffed Grouse, or "Partridge," and the Yellow-rumped Warbler. In the insect work I have had regularly the valued assistance of Mr. W. F. Fiske, and during the summer vacation Mr. R. A. Cushman added a large number of specimens to the insect collection. Most of the drawings for the entomological bulletins have been made by Mr. Joseph Bridgham.

Clarence M. Weed,
Entomologist.

DEPARTMENT OF BACTERIOLOGY

Since the last report this department has been working along the following lines:

Study of the bacteriology of ensilage. In this connection a series of experiments in taking temperatures in the silo by electrical means has been completed and another begun.

Study of the root tubercles of the leguminous plants.

Study and treatment of leaf and fruit spot of apple.

Study of life-history and treatment of black knot.

Study of the fungi and bacteria concerned in the decay of fruit with especial reference to the apple.

As an introduction to future bulletins the following summary of the principal general facts in regard to bacteria is here given:

Any one who gives the subject a moment's consideration cannot help being impressed by the wonderful variety of the plants which make up the grand division of living things known as the vegetable kingdom, but no one, who has not given special study to the subject, can have any adequate idea how great and how wonderful this variety is. Besides the plants which make up the greater part of the vegetation that clothes the earth's surface, and at the same time offer to man materials for food, clothing, houses, and innumerable luxuries, there are others which, while of the highest interest to the botanist or biologist, receive from the majority of people very little consideration, either because of their lack of economic importance or because of their small size, which renders them difficult of observation. Such plants are the mosses, the lichens, the algæ, and the fungi, which are considered to occupy a lower position in the scale of vegetable life than those with which we are most familiar. Lower still than these is a group of plants which, although the smallest members of the vegetable kingdom, are far from being the least important. Not only are they of interest to the botanist, but more and more it is coming to be recognized that they are of great economical and therefore of great practical importance. These plants are

the ones which are frequently spoken of as *germs, microbes,* or *micro-organisms,* and whose proper botanical name is *bacteria.* As has been intimated, the bacteria are the smallest plants of which we have any knowledge. Because of their extreme minuteness, their existence was not known until the microscope came as an aid and an extension to ordinary vision. After their discovery comparatively little information of importance in regard to their nature and function was acquired until the latter half of the present century.

The form and structure of bacteria are extremely simple, and show so little variety that, in appearance, different species

Fig. 54. Forms of Bacteria.

resemble one another very closely. Three principal forms are recognized: those which have the shape of little balls or spheres known as *micrococci*; those which are elongated and round, like a short pencil, known as *bacilli*; and those which are spiral or corkscrew-shaped known as *spirilla.* Fig. 54 shows the different forms as they appear under a moderately high power of

the microscope. Their size, though variable, is always very minute and even the highest powers of the microscope tell us but little in regard to their internal structure; therefore in studying bacteria and attempting to classify them, more attention is directed to what they do than to their form and structure; in other words, their physiological characteristics are of more importance than their anatomical ones.

The following are some of the more important facts in the life-history of the bacteria:

Size. They are so small that from ten to twenty-five thousand micrococci would be required to form a chain an inch long; from three to twenty thousand bacilli placed end to end would only aggregate the same length. In a mass no larger than the head of a pin there would be several millions of bacteria.

Distribution. Bacteria may be carried from place to place in various ways, but their chief means of distribution is by particles of dust floating in the air. They are found in the air, in water, in the soil, on all surfaces exposed to the air, and especially wherever decay is going on, being themselves the active agents in producing it.

Food. The food of bacteria consists of organic matter, that is, of substances that form a part or that have formed a part of some plant or animal.

Moisture. Bacteria can thrive only where there is moisture; while drying does not necessarily kill them, it completely checks their growth.

Oxygen. Some bacteria will grow only in the presence of oxygen; others only in its absence; while still others tolerate either condition.

Temperature. There is a certain temperature at which bacteria grow best; this varies in the different species, but for most lies somewhere between sixty and one hundred degrees Fahrenheit. As the temperature approaches the freezing point it becomes more and more unfavorable for them, and at or near that point all or nearly all cease to be active, though they may not be killed and may resume their activity when a higher

temperature is restored. As the temperature rises above one hundred it rapidly becomes unfavorable; different species have different resisting power, but all or nearly all perish after a few minutes' exposure somewhere between one hundred and twenty and two hundred and twelve, the temperature of boiling water. The spores which some species produce are much more resistant than the bacteria themselves; this fact has to be taken into account in using heat as a disinfectant.

Reproduction. The bacteria reproduce in a very simple way; a given microbe divides into two portions, each of which becomes an independent bacterium; these two in their turn produce two each, and so on indefinitely. When the conditions are favorable reproduction is very rapid, so that in the course of twenty-four hours the offspring of a single bacterium may number millions. In addition to this method some bacteria form special reproductive bodies called spores, which serve the same purpose as seeds in the higher plants. Spores retain their vitality under conditions that would kill the microbes themselves.

What is the role which bacteria play in nature? We know that plants and animals are continually dying; we also know that their bodies, after a longer or shorter period, disappear, leaving behind only a small amount of matter which finally becomes mixed with the soil, while the bulk of the substances composing them disappears as gases. None of these materials are lost, however, but somewhere and sometime they may and do enter into the composition of a new plant or animal. The chief agents in the production of this decomposition or decay of dead matter are the bacteria. They find in the dead organic matter the materials which serve them as food and when the other conditions are favorable they develop rapidly. As a result of their activity the original compounds are broken up and new ones are formed, usually simpler ones. These various changes are spoken of as fermentations; when they are accompanied by the production of foul odors, as in the decay of animal substances, the process is termed putrefaction. Some of the new substances are useful, others are harmless or indifferent, while still others are violent poisons.

Certain bacteria grow and flourish only under such conditions as are to be found in a living plant or animal; these are the parasitic or disease-producing bacteria. It is largely to the study of their relation to animal diseases that bacteriology owes its, in late years, rapid development. The disease-producing bacteria gain entrance to the animal body through the breathing or digestive apparatus or through wounds. In many cases when they gain entrance to the healthy body, though they find most of the conditions favorable to their development, they encounter a natural resistance which they are unable to overcome, and, as a consequence, perish without doing any serious damage. In other cases, owing to some unhealthy condition of the body in which the natural resistance is lost or weakened, the bacteria gain a foothold and develop, producing their characteristic disease. Tuberculosis or consumption, typhoid fever, diphtheria, cholera, lockjaw, anthrax, hog-cholera, and glanders are well-known examples of bacterial diseases.

While the farmer or housekeeper may never have seen bacteria, or may even be ignorant of their existence, yet they do things every day the fundamental reason for which has to do in some way with these tiny plants. Food, after it is cooked, if not used at once, is reheated or scalded after a few days "to keep it from spoiling"; the original cooking destroyed all or most of the bacteria present in the material; after twenty-four or forty-eight hours the few germs that may have been able to withstand the heat used, or new germs that may have fallen from the air, begin to develop, and would soon "spoil" the food if they were not killed by reheating. The essential thing in preserving fruit, meat, or other food by canning is to destroy by heat all bacteria present and by sealing up while hot to keep out any new ones. Food materials are kept in refrigerators because the low temperature produced by the ice is unfavorable to and retards the development of bacteria. The temperature of ordinary refrigerators, however, is not usually low enough to wholly check development, hence the things spoil after a time. The reason for the various applications of heat and cold in the dairy may readily be inferred. Corn and other

green fodder packed in the silo "keeps" because the packing excludes to a greater or less degree the oxygen of the air which is necessary for the development of the decay-producing bacteria. Certain substances, such as salt, sugar, smoke, are used to preserve food materials because they are unfavorable to the bacteria. The terms "pasteurization" and "sterilization" are frequently used in connection with the handling of various food products. A sterilized substance is one which has been subjected to a degree of heat, usually the boiling temperature, sufficient to kill all the bacteria and their spores which it may have originally contained. Many substances, *e. g.*, milk, cannot bear such a temperature without injury; a lower degree of heat, however, may be applied to them in such a way as to destroy most of the germs present, especially those likely to produce disease, without injury; this is pasteurization.

Anything which kills bacteria is a disinfectant. One of the best disinfectants is heat at the boiling temperature or higher. Besides heat certain chemical disinfectants are in frequent use, especially in dealing with disease germs; the most common are corrosive sublimate, formalin, carbolic acid, fumes of burning sulphur, and "chloride of lime." These are poisonous to animal life as well as to bacteria, and therefore must be used with care. A substance, which, while not necessarily fatal to bacteria, retards their growth, is called an antiseptic; sugar and salt, mentioned above, are such substances. Cold is to be considered as an antiseptic. Salicylic acid and boric acid are antiseptics which are sometimes used to preserve food; but any chemical food-preservative other than sugar and salt should be looked upon with suspicion as likely to be injurious to health.

Leaving out of account the disease-producing ones, bacteria are of great interest to those engaged in agriculture, from the intimate relation they sustain to many of the operations which are continually in progress on the farm, some of which have already been hinted at. In dairy work bacteria in great variety have to be dealt with; not only is the souring of the milk and the ripening of the cream due to their activity, but various other changes, desirable or the contrary, are brought about by

these omnipresent little plants. The milkman desires to suppress them entirely; the butter and cheese maker seeks to encourage the development of some species and to suppress that of others. In the manure pile myriads of bacteria are working, according to circumstances, rendering the contained plant-food more available on the one hand, or causing its loss on the other. In the soil they are working with the same variable result. Certain bacteria or bacteria-like plants grow on the roots of peas, clover, vetches, and related plants (the legumes), producing little nodules or tubercles; in some way they seem to enable the legumes to make use of a portion of the vast supply of nitrogen contained in the atmosphere, from which use most plants seem to be barred. As a more extended knowledge of the bacteria is acquired, it is more than possible that we shall be able to control their activity where heretofore it has been left to chance with variable result.

H. H. Lamson,
Bacteriologist.

DEPARTMENT OF METEOROLOGY AND AGRICULTURAL ENGINEERING

I. Meteorology

Observations have been continued as during previous years with Charles T. Staniels, New Hampshire College, class of 1901, acting as observer during most of the year.

Signal flags have been displayed each day, except Sundays and holidays, throughout the year from the tower of the experiment station building, indicative of the weather for the succeeding night and day. In addition a synopsis of weather conditions has been written each day upon the blackboard at the station building for the benefit of the station workers.

A Draper self-recording thermometer has been added to the equipment, and it has proved very useful in checking the maximum and minimum daily readings, as well as in other ways. A wet bulb thermometer to indicate the humidity of the air has also been procured, and its readings taken during the growing season from April to November.

The excessive rainfall of the past few years continued till April 1, 1899. At that time the soil was thoroughly saturated with moisture and all springs were running full. Then came a sudden change, and the last three months of the year were abnormally dry, with a total precipitation of only 3.6 inches. Indeed this lack of rain was the chief feature of the weather for the year, and had a marked effect upon farm crops, especially grass, the amount of hay harvested in this vicinity being about one half of that of the previous year. Hoed crops on heavy soil did not suffer seriously.

The year was rather remarkable for a lack of extremes in temperature, leaving the average about normal. No excessive hot spells in summer or cold in winter were registered. No killing frost occurred till October 10, vegetation holding green in general till that date.

October was the month of largest rainfall, in striking contrast to the previous year when it was the driest month. Winter started in early with a heavy snowfall in November, but the snow did not last for sleighing. The total snowfall was about the same as for the previous year. Thunder storms were numerous through the summer season, but no remarkable storms of any kind were registered either in summer or winter.

II. Agricultural Engineering

The college steam drill has been in use twice during the year and these occasions were utilized for class instruction in road building. Practical instruction was also given in the use of the derrick. A survey was made by the class in roads with the aid of the grade level and chain, of a proposed change of location of a public road for the improvement of its grade.

Through the kindness of the Climax Road Machine Company, a complete plant for elevating and screening gravel was placed at the disposal of the writer for experimental road work. The machine has been set up at the gravel bank near the reservoir. It was found necessary to make changes in the screening apparatus in order to obtain the best results, and experiments are still going forward which later will be reported in detail in bulletin form.

A somewhat extensive permanent improvement has been nearly completed upon the westerly end of the land assigned to the experiment station. The brook there was very winding and the land near it too wet for general cultivation. The brook has been straightened and deepened for some five hundred feet in length, and the land on either side has been sloped with an easy grade, the soil thus obtained being used to fill the low ground and the former bed of the brook. The result is the securing of two fields, one on either side of the brook, of even surface and deep soil, suitable for almost any farm purpose, where before nothing but swale grass and alder bushes grew. The same method of improvement may be applied later with advantage to the easterly half of the same field.

In May, 1899, a paper on "Road Drainage" was read before the state road convention at Lancaster, N. H., and talks on kindred subjects were given at other places during the year.

C. H. Pettee,
Meteorologist.

METEOROLOGICAL TABLES

METEOROLOGICAL.

DURHAM, STRAFFORD COUNTY, NEW HAMPSHIRE. LAT. 43° 8′ N.

July, 1888.	8 A. M.		8 P. M.		TEMPERATURE.								
	Attached thermometer.	Barometer.	Attached thermometer.	Barometer.	8 a. m.	8 p. m.	Mean.	8 a. m., wet.	8 p. m., wet.	Maximum.	Minimum.	Mean.	Range.
1	75.	29.588	80.	29.844	69.	76.	72.5	.....	.....	85.	54.	69.5	31.
2	80.	29.956	78.	29.842	73.	68.	70.5	.....	.....	85.	56.	70.5	29.
3	89.	29.746	91.	29.620	80.	87.	83.5	.....	.....	98.	65.	81.5	33.
4	92.	29.606	84.	29.6	84.	78.	81.	.....	.....	93.	73.	83.	20.
5	90.	29.838	75.	29.908	68.	64.	66.	.....	.....	78.	61.	69.5	17.
6	74.	30.02	80.	29.966	66.	65.	65.5	.....	.....	77.	49.	67.	36.
7	75.	29.928	78.	29.802	69.	66.	67.5	.....	.....	82.	49.	65.5	33.
8	78.	29.670	85.	29.494	73.	77.	75.	.....	.....	90.	56.	73.	34.
9	80.	29.414	80.	29.502	72.	65.	75.5	.....	.....	82.	67.	74.5	15.
10	70.	29.596	70.	29.712	65.	61.	63.	.....	58.5	69.	49.	59.	20.
11	73.	29.884	70.	29.984	65.	58.	68.5	55.	56.	71.	48.	59.5	23.
12	68.	30.172	70.	30.178	60.	58.	59.	55.	56.	68.	52.	60.	16.
13	65.	30.1	65.	29.938	55.	56.	55.5	55.	56.	59.	53.	56.	+6.
14	73.	29.94	78.	29.722	67.	67.	67.	64.	67.	85.	55.	70.	30.
15	76.	29.51	80.	29.608	74.	72.	73.	70.	62.	83.	65.	74.	18.
16	82.	29.648	80.	29.792	72.	72.	72.	61.	57.	82.	62.	72.	20.
17	80.	29.8	76.	29.776	71.	66.	68.5	60.	.....	81.	54.	67.5	27.
18	77.	29.832	80.	29.788	70.	71.	70.5	64.	69.5	80.	60.	70.	20.
19	78.	29.718	85.	29.702	73.	77.	75.	71.	72.	87.	63.	75.	24.
20	82.	29.692	84.	29.652	77.	75.	76.	72.	73.	85.	72.	78.5	13.
21	79.	29.704	80.	29.752	71.	70.	70.5	71.	68.	85.	68.	76.5	17.
22	77.	29.918	77.	29.953	70.	67.	68.5	66.	59.	80.	65.	80.5	15.
23	76.	30.022	75.	29.952	67.	63.	65.	65.	58.	78.	55.	66.5	23.
24	65.	29.934	75.	29.910	63.	65.	64.	59.	60.	80.	61.	70.5	19.
25	72.	29.862	75.	29.732	67.	72.	69.5	66.	68.	75.	62.	68.5	13.
26	75.	29.698	78.	29.73	71.	72.	71.5	70.	70.	78.	68.	72.	10.
27	75.	29.724	76.	29.751	67.	67.	67.	67.	67.	81.	58.	69.5	23.
28	73.	29.582	77.	29.613	66.	65.	65.5	66.	64.	78.	64.	71.	14.
29	75.	29.600	85.	29.553	72.	78.	75.	70.	77.	90.	68.	79.	22.
30	85.	29.622	83.	29.636	83.	74.	78.5	80.	72.	95.	69.	82.	26.
31	75.	29.714	72.	29.704	72.	67.	69.5	65.	65.	78.	67.	72.5	11.
Sum	.....	.....	.....	.....	2172.	2149.	2169.5	.....	.....	2518.	1878.	.....	.....
Mean.	.....	.....	.....	.....	70.+	69.3+	70—	.....	.....	81.2+	60.6—	.....	.....

RECORD

LONG. 70° 56′ W. BAROMETER 125 FEET ABOVE SEA LEVEL

July, 1888.	Precipitation.				Prevailing wind direction.	Character of day.	Remarks.
	Time of beginning.	Time of ending.	Total amount in inches.	Snowfall in inches.			
1					S. E.	Clear.	Maximum temperature, 98; date, 3d.
2					S. E.	Clear.	
3					S. W.	Clear.	Minimum temperature, 48; date, 11th.
4					N. W.	Clear.	
5					S. E.	Clear.	Mean temperature (mean max.+mean min.÷2), 70.8.
6					S. E.	Clear.	
7					S. E.	Clear.	
8					S. W.	Clear.	Mean temperature (8+8÷2), 70.
9	Showers.		.02		S. E.	Partly cloudy.	
10					S. E.	Partly cloudy.	Mean max. temperature, 81.2; mean min. temperature, 60.6.
11	During night.				S. E.	Partly cloudy.	
12		During night.	.84		E.	Partly cloudy.	Total precipitation, 1.75 inches.
13					E.	Cloudy.	
14					S. E.	Clear.	Greatest precipitation in any 24 consecutive hours, .84; date, 11th and 12th.
15					N. W.	Partly cloudy.	
16					N. W.	Clear.	
17	During night.				S. E.	Partly cloudy.	Number of clear days, 12; partly cloudy, 14; cloudy, 5; on which .01 or more precipitation fell, 9.
18		During night.	.06		S. E.	Partly cloudy.	
19					S. W.	Partly cloudy.	
20					S. E.	Partly cloudy.	
21	3 p. m.	6 p. m.	.73		W.	Partly cloudy.	Prevailing wind direction, S. E. 21st, heavy thunder storm in p. m.
22					S. E.	Partly cloudy.	
23	8 a. m.				S. E.	Cloudy.	
24		During night.	.07		S. E.	Clear.	
25					S.	Cloudy.	
26	Showers.		.02		S.	Partly cloudy.	
27					S. E.	Cloudy.	
28	Showers.		.01		S.	Cloudy.	
29					S. E.	Partly cloudy.	
30	Showers.		.01		S. W.	Partly cloudy.	
31					E.	Clear.	
Sum ...			1.75				

METEOROLOGICAL

DURHAM, STRAFFORD COUNTY, NEW HAMPSHIRE. LAT. 43° 8′ N.

August, 1898.	8 A. M.		8 P. M.		TEMPERATURE.								
	Attached thermometer.	Barometer.	Attached thermometer.	Barometer.	8 a. m.	8 p. m.	Mean.	8 a. m., wet.	8 p. m., wet.	Maximum.	Minimum.	Mean.	Range.
1	71.	29.822	72.	29.776	67.	66.	66.5	64.	65.5	72.	63.	67.5	9.
2	76.	29.714	79.	29.760	73.	74.	73.5	71.	65.	85.	65.	75.	20.
3	79.	29.812	78.	29.754	76.	71.	73.5	72.	69.5	84.	61.	72.5	23.
4	77.	29.714	85.	29.636	71.	80.	75.5	69.	79.5	88.	68.	78.	20.
5	76.	29.636	76.	29.666	68.	66.	67.	68.	62.5	74.	66.	70.	8.
6	75.	29.738	75.	29.670	67.	71.	69.	60.	65.	82.	55.	68.5	27.
7	78.	29.652	80.	29.636	71.	73.	72.	64.	67.	85.	59.	72.	26.
8	77.	29.590	80.	29.562	72.	77.	74.5	71.	74.5	87.	66.	76.5	21.
9	79.	29.578	88.	29.662	72.	74.	73.	69.	70.	84.	69.	76.5	15.
10	73.	29.666	67.	29.752	67.	61.	64.	63.	61.	68.	64.	66.	4.
11	65.	29.736	65.	29.772	63.	64.	63.5	62.	61.	69.	60.	69.5	9.
12	72.	29.802	.....	.....	68.	65.	66.5	63.	.....	72.	61.	66.5	11.
13	71.	29.744	75.	29.330	67.	64.	65.5	66.5	61.	82.	61.	71.5	21.
14	70.	29.722	74.	29.956	65.	66.	65.5	62.5	62.	83.	54.	68.5	29.
15	71.	29.964	73.	29.918	67.	66.	66.5	64.5	63.	80.	57.	68.5	23.
16	71.	29.812	82.	29.712	65.	76.	70.5	62.	72.	85.	55.	70.	30.
17	77.	29.662	80.	29.650	71.	76.	73.5	68.5	73.	87.	64.	75.5	23.
18	78.	29.698	72.	29.692	73.	71.	72.	69.	69.5	85.	52.	63.5	23.
19	69.	29.680	68.	29.640	66.	65.	65.5	65.	63.	68.	54.	61.	14.
20	69.	29.740	70.	29.710	65.	72.	63.5	63.	61.	70.	59.	64.5	11.
21	69.	29.691	73.	29.642	66.	73.	69.5	65.	72.	86.	54.	70.	32.
22	77.	29.572	83.	29.552	73.	76.	74.5	68.	72.	88.	51.	69.5	37.
23	78.	29.606	78.	29.536	74.	67.	75.5	70.	67.	87.	67.	77.	20.
24	80.	29.562	78.	29.584	79.	69.	74.	73.	69.	92.	67.	79.5	25.
25	76.	29.530	79.	29.454	69.	71.	70.	68.5	69.5	82.	65.	73.5	17.
26	80.	29.494	71.	29.584	68.	63.	65.5	62.	57.	78.	61.	69.5	17.
27	72.	29.676	68.	29.804	62.	62.	62.	53.	56.	70.	55.	62.5	15.
28	68.	29.978	72.	29.934	52.	64.	58.	55.	64.	82.	44.	63.	38.
29	68.	29.888	68.	29.742	58.	61.	59.5	58.5	67.5	70.	47.	58.5	23.
30	70.	29.716	76.	29.712	61.	71.	66.	62.5	70.	73.	63.	68.	10.
31	70.	29.692	72.	29.714	65.	74.	69.5	.....	.....	85.	61.	73.	24.
Sum....	.....	.....	.....	.....	2101.	2159.	2125.	.....	.....	2483.	1848.	.....	
Mean..	.....	.....	.....	.....	67.7+	69.6+	68.5	.....	.....	80.0+	59.6	.....	

RECORD

LONG. 70° 56′ W. BAROMETER 125 FEET ABOVE SEA LEVEL

August, 1898.	Precipitation.				Prevailing wind direction.	Character of day.	Remarks.
	Time of beginning.	Time of ending.	Total amount in inches.	Snowfall in inches.			
1	Showers.		*	.....	S. E.	Cloudy.....	Maximum temperature, 92; date, 24th. Minimum temperature, 44; date, 28th. Mean temperature (mean max. + mean min. ÷ 2), 69.8. Mean temperature (8 + 8 ÷ 2), 68.7. Mean max. temperature, 80; mean min. temperature, 59.6. Total precipitation, 5.92 inches. Greatest precipitation in any 24 consecutive hours, 1.28; date, Aug. 5. No. of clear days, 9; partly cloudy, 15; cloudy, 7; on which .01 or more precipitation fell, 12. Prevailing wind direction, S. W. 23d, 24th, and 25th, heavy thunder showers. Damage by lightning on 23d, and by wind on 25th.
2	.....	.....	.....	.....	S. W.	Clear.....	
3	.....	.....	.....	.....	S. E.	Partly cloudy..	
4	During night.		.26	.....	S. E.	Partly cloudy..	
5	During night.	12 m.	1.28	.....	E.	Partly cloudy..	
6	.....	.....	.....	.....	S. E.	Partly cloudy..	
7	.....	.....	.....	.....	W.	Clear.....	
8	During night.	8.30 a. m.	.19	.....	S. W.	Partly cloudy..	
9	During night.		.05	.....	S. E.	Partly cloudy..	
10	.....	.....	.....	.....	E.	Cloudy.....	
11	During night.	9 a. m.	.65	.....	N. E.	Cloudy.....	
12	Showers.		.02	.....	E.	Cloudy.....	
13	Showers.		.05	.....	W.	Partly cloudy..	
14	.....	.....	.....	.....	S. E.	Partly cloudy..	
15	6 a. m.	.....	*	.....	S. E.	Clear.....	
16	.....	.....	.....	.....	S.	Partly cloudy..	
17	.....	.....	.....	.....	S. W.	Clear.....	
18	.....	.....	.....	.....	S.	Partly cloudy..	
19	8 a. m.	8 p. m.	1.19	.....	N.W.	Cloudy.....	
20	During night.		.02	.....	S. E.	Partly cloudy..	
21	.....	.....	.....	.....	N. E.	Partly cloudy..	
22	.....	.....	.....	.....	S. W.	Partly cloudy..	
23	6 p. m.	8 p. m.	1.10	.....	S. W.	Partly cloudy..	
24	6 p. m.	During night.	.55	.....	S. W.	Partly cloudy..	
25	Showers.		.56	.....	S. W.	Cloudy.....	
26	.....	.....	.....	.....	W.	Clear.....	
27	.....	.....	.....	.....	W.	Clear.....	
28	.....	.....	.....	.....	W.	Clear.....	
29	.....	.....	.....	.....	S. W.	Cloudy.....	
30	.....	.....	.....	.....	S. W.	Clear.....	
31	.....	.....	.....	.....	W.	Clear.....	
Sum...	.....	.....	5.92	.....			
.....	.....	.....	.....	.....			

* Trace.

METEOROLOGICAL

DURHAM, STRAFFORD COUNTY, NEW HAMPSHIRE. LAT. 43° 8′ N.

September, 1898.	8 A. M.		8 P. M.		TEMPERATURE.						
	Attached thermometer.	Barometer.	Attached thermometer.	Barometer.	8 a. m.	8 p. m.	Mean.	Maximum.	Minimum.	Mean.	Range.
1	78.	29.788	80.	29.752	76.	73.	74.5	83.	68.	75.5	15.
2	80.	29.724	78.	29.476	73.	68.	70.	79.	65.	72.	14.
3	80.	29.484	78.	29.632	77.	68.	72 5	88.	63.	75.	25.
4	75.	29.666	78.	29.588	63.	75.	69.	81.	61.	71.	20.
5	79.	29.624	80.	29.604	79.	70.	72.	85.	66.	75.5	19.
6	76.	29.644	70.	29.632	73.	68.	70.5	86.	63.	74.5	23.
7	80.	29.556	76.	29.522	74.5	67.	70.5	89.	63.	76.	26.
8	71.	29.840	70.	29.916	73.	59.	61.	80.	55.	67.5	25.
9	68.	30.013	71.	30.008	62.	61.	61.5	78.	49.	63.5	29.
10	65.	29.921	67.	29.976	58.	59.	58.5	77.	47.	62.	30.
11	60.	29.914	65.	29.890	53.	54.5	53.5	79.	42.	60.5	37.
12	63.	29.902	60.	30.084	57.	51.5	54.	68.	47.	57.5	21.
13	63.	30.246	66.	30.020	52.	57.	54.5	72.	38.	55.	34.
14	64.	29.910	66.	29.920	55.	55.	55.	74.	40.	57.	34.
15	62.	29.844	67.	29.822	53.	62.	57.5	69.	42.	55.5	27.
16	66.	29.742	60.	29.660	62.	65.	63.5	74.	58.	56.	16.
17	72.	29.688	72.	29 506	69.	63.	66.	81.	61.	71.	20.
18	68.	29.626	72.	29.492	60.	61.	60.5	81.	50.	65.5	31.
19	71.	29.524	68.	29.594	63.	55.	59.	70.	57.	63.5	13.
20	64.	29.644	60.	29.824	54.	49.	51.5	62.	45.	53.5	17.
21	59.	30.030	58.	29.994	47.	49.	48.	64.	38.	51.	26.
22	62.	29.926	60.	29.804	52.	62.	57.	74.	42.	58.	32.
23	64.	29.520	62.	29.494	59.	64.	61.5	76.	58.	67.	18.
24	61.	29.518	54.	29.854	50.	46.	48.	49.	49.	49.	.....
25	52.	29.848	54.	29.752	46.	50.	48.	54.	44.	49.	10.
26	59.	29.618	60.	29.434	56.	56.	56	71.	50.	60.5	21.
27	60.	29.348	59.	29.577	56.	51.	53.5	61.	48.	54.5	13.
28	68.	29.718	68.	29.804	54.	52.	53.	70.	46.	58.	24.
29	61.	29.810	70.	29.816	49.	63.	56.	77.	40.	58.5	37.
30	70.	29.914	70.	29.864	59.	60.	59.5	77.	48.	62.5	29.
Sum ...	.....	.....	.....	.....	1811.	1794.	1795.5	2229.	1543.	1875.	686.
Mean ..	.....	.....	.....	.....	60.3+	59.8	59.8	74.3	51.4	62.5	22.8

RECORD

LONG. 70° 56′ W. BAROMETER 125 FEET ABOVE SEA LEVEL

September, 1898.	Precipitation.				Prevailing wind direction.	Character of day.	Remarks.
	Time of beginning.	Time of ending.	Total amount in inches.	Snowfall in inches.			
1					S. W.	Partly cloudy..	Maximum temperature, 89: date, 7th.
2	7.15 p. m.	9 p. m.	.12		W.	Partly cloudy..	
3					W-E	Clear	Minimum temperature, 38: date, 13th and 21st.
4	7.30 p. m.				S. W.	Cloudy	
5		During night.	.06		S. E.	Partly cloudy..	Mean temperature (mean max. + mean min.÷2), 62.8.
6					S.	Clear	
7	2.30 p. m.				S.	Partly cloudy..	
8		During night.	1.21		S. E.	Clear	Mean temperature (8+8÷2), 60.1.
9					S.	Clear	Mean max. temperature, 74.3: mean min. temperature, 51.4.
10					S. W.	Clear	
11					W.	Clear	
12					S. W.	Clear	
13					S.	Partly cloudy..	Total precipitation, 3.57 inches.
14					S.	Partly cloudy..	
15					S. E.	Cloudy	Greatest precipitation in any 24 consecutive hours, 1.21: date, 8th.
16					S. E.	Partly cloudy..	
17					N.	Clear	
18					S. W.	Partly cloudy..	
19	During night.		.18		W.	Cloudy	No. of clear days, 14: partly cloudy, 10: cloudy, 6; on which .01 or more precipitation fell, 7.
20					N. W.	Partly cloudy..	
21					W.	Clear	
22					S. W.	Partly cloudy..	
23					N. E.	Cloudy	
24	During night.	10 a. m.	.18		N. E.	Cloudy	Prevailing wind direction, W. and S. W.
25	6 p. m.	During night.	1.06		E.	Cloudy	Dates of frost, *very light* on 13th: light on 21st.
26					W.	Clear	
27	During night.		.76		N.	Clear	
28					N. W.	Clear	Evening of 2d, much lightning, little rain.
29					W.	Clear	
30						Clear	Evening of 4th, much lightning, little rain.
							Afternoon of 7th, three heavy thunder showers in succession, clearing between each; gentle rain after last one into night.
Sum			3.57				

METEOROLOGICAL

DURHAM, STRAFFORD COUNTY, NEW HAMPSHIRE. LAT. 43° 8′ N.

October, 1898.	8 A. M.		8 P. M.		TEMPERATURE.								
	Attached thermometer.	Barometer.	Attached thermometer.	Barometer.	8 a. m.	8 p. m.	Mean.	8 a. m., wet.	8 p. m., wet.	Maximum.	Minimum.	Mean.	Range.
1	69.	30.002	73.	30.200	62.	65.	63.5	59.	63.	71.	51.	61.	20.
2	65.	30.146	68.	30.028	61.	55.	59.	59.	55.	80.	54.	67.	26.
3	67.	29.960	75.	29.864	57.	72.	64.5	57.	69.	68.	53.	60.5	15.
4	74.	29.840	77.	29.880	72.	71.	71.5	69.	70.	84.	67.	70.5	7.
5	68.	29.842	65.	29.754	55.	53.	54.	53.	53.	83.	52.	67.5	31.
6	67.	29.900	66.	30.140	54.	43.	48.5	46.	41.	62.	43.	52.5	19.
7	67.	30.144	64.	30.020	47.	54.	50.5	44.	51.	60.	34.	47.	26.
8	67.	29.880	68.	29.664	50.	54.	52.	49.	54.	64.	49.	56.5	15.
9	65.	29.762	66.	29.846	51.	48.	49.5	47.	42.	58.	43.	50.5	15.
10	58.	30.182	60.	29.922	40.	42.	41.	36.	40.	63.	29.	46.	34.
11	56.	29.986	69.	29.568	47.	61.	54.	46.	59.	55.	38.	46.5	17.
12	65.	29.442	65.	29.504	58.	53.	55.5	57.	47.	69.	41.	55.	28.
13	65.	29.720	62.	29.744	46.	45.	45.5	41.	44.	70.	39.	54.5	31.
14	59.	29.860	59.	29.646	45.	49.	47.	43.	46.	58.	38.	48.	20.
15	57.	29.404	60.	29.422	48.	42.	45.	47.	37.	54.	42.	48.	12.
16	58.	29.620	52.	29.842	42.	40.5	41.2	36.	40.	50.	38.	44.	12.
17	59.	29.984	58.	30.048	39.	39.	39.	35.	36.	49.	32.	40.5	17.
18	59.	30.066	59.	30.040	35.	36.	35.5	35.	35.	51.	29.	40.	22.
19	59.	30.020	59.	29.808	46.	49.5	47.7	42.	49.	48.	32.	40.	16.
20	62.	29.884	62.	29.946	50.	52.	51.	48.	50.	51.	44.	47.5	7.
21	58.	29.960	62.	29.840	41.	48.	44.5	40.	48.	65.	42.	53.5	23.
22	61.	29.300	69.	29.188	57.	66.	61.5	57.	65.	62.	48.	55.	14.
23	61.	29.418	60.	29.804	50.	48.	49.	45.	44.	68.	46.	57.	22.
24	60.	30.018	63.	30.000	47.	52.	49.5	44.	48.	59.	39.	49.	20.
25	68.	30.000	65.	29.920	44.	52.	48.	43.	51.	65.	39.	52.	26.
26	62.	29.800	67.	29.426	57.	62.5	59.7	56.	62.	62.	47.	54.5	15.
27	65.	29.428	65.	29.792	48.	39.	43.5	44.	34.	65.	38.	51.5	27.
28	61.	30.022	63.	30.166	36.	34.	35.	35.	33.	52.	30.	41.	22.
29	60.	30.102	62.	29.950	38.	44.	41.	35.	44.	48.	30.	39.	18.
30	.....	.....	.....	.....	44.	45.	44.5	43.	45.	45.	41.	43.	4.
31	.....	.....	.....	.....	37.	41.	39.	36.	38.	50.	38.	44.	12.
Sum...	.....	.....	.....	.....	1504.	1553.5	1530.6	.....	.....	188.9	1286.	1582.5	593.
Mean..	.....	.....	.....	.....	48.5	50.2	49.4	.....	.....	60.9	41.2	51.	18.1

RECORD

LONG. 70° 56′ W. BAROMETER 125 FEET ABOVE SEA LEVEL

October, 1898.	Precipitation.				Prevailing wind direction.	Character of day.	Remarks.
	Time of beginning.	Time of ending.	Total amount in inches.	Snowfall in inches.			
1					E.	Clear.	Maximum temperature, 84; date, 4th.
2					S. W.	Partly cloudy.	
3					S. W.	Partly cloudy.	Minimum temperature, 29; date, 10th and 18th.
4					W.	Partly cloudy.	
5	During night.				N.E.	Cloudy.	
6			2.01		N.W.	Clear.	Mean temperature (mean max.+mean min.÷2), 51.05.
7	10 a. m.		.53		S.	Partly cloudy.	
8		10 a. m.	.02		W.	Cloudy.	
9					W.	Clear.	Mean temperature (8+8÷2), 49.3.
10					S. W.	Clear.	
11					S. W.	Clear.	Mean max. temperature, 60.9; mean min. temperature, 41.2.
12	During night.		.15		W.	Partly cloudy.	
13					W.	Partly cloudy.	
14					N.	Cloudy.	
15	Night.		1.1		N.W.	Cloudy.	Total precipitation, 7.62 inches.
16					N.W.	Clear.	
17					N.E.	Clear.	Greatest precipitation in any 24 consecutive hours, 2.01; date, 6th.
18					S. E.	Partly cloudy.	
19	1 p. m.				N.E.	Cloudy.	
20		During night.	1.08		N.E.	Cloudy.	Number of clear days, 8; partly cloudy, 12; cloudy, 11; on which .01 or more precipitation fell, 10.
21	Night.				E.	Cloudy.	
22		3 p. m.	1.37		S.	Cloudy.	
23					W.	Partly cloudy.	Prevailing wind, W. S. W.
24					S.	Partly cloudy.	
25					S.	Partly cloudy.	
26	8.30 a. m.	7 p. m.	1.22		S.	Cloudy.	Dates of frost, 7th and 10th.
27					S.	Partly cloudy.	
28					S. E.	Clear.	
29	9 a. m.				S.	Cloudy.	
30		10 p. m.	.14		S.W.	Cloudy.	
31					S.W.	Partly cloudy.	
Sum ...			7.62				

METEOROLOGICAL

DURHAM, STRAFFORD COUNTY, NEW HAMPSHIRE. LAT. 43° 8′ N.

November, 1888.	8 A. M.		8 P. M.		TEMPERATURE.								
	Attached thermometer.	Barometer.	Attached thermometer.	Barometer.	8 a. m.	8 p. m.	Mean.	8 a. m., wet.	8 p. m., wet.	Maximum.	Minimum.	Mean.	Range.
1	68.	29.940	66.	30.012	40.	39.	39.5	36.	37.	50.	34.	42.	16.
2	60.	29.842	61.	29.904	44.	48.	46.	42.	45.	52.	34.	43.	18.
3	63.	30.120	60.	30.134	43.	41.	42.	38.	38.	61.	38.	49.5	23.
4	64.	30.218	66.	30.112	39.	41.	40.	46.	40.5	61.	28.	44.5	33.
5	62.	30.002	66.	29.700	36.	49.	42.5	36.	49.	58.	27.	42.5	31.
6	64.	29.264	58.	29.314	59.	45.	52.	59.	45.	59.	43.	51.	16.
7	57.	29.596	60.	29.916	40.	35.	37.5	35.5	34.	59.	35.	47.	24.
8	55.	29.982	58.	29.894	31.	48.	37.5	32.	42.	43.	26.	34.5	17.
9	59.	29.960	66.	30.026	45.	48.	46.5	42.	45.	60.	43.	51.5	17.
10	56.	29.982	55.	29.420	34.	34.	34.	34.	34.	59.	31.	45.	28.
11	56.	29.300	54.	29.624	36.	35.	35.5	36.	31.	37.	35.	36.	2.
12	55.	29.922	62.	29.950	32.	33.	32.5	27.	29.	45.	28.	36.5	17.
13	57.	29.950	54.	29.744	28.	45.	36.5	32.	44.	44.	22.	33.	22.
14	55.	29.500	59.	29.508	41.	39.	40.	41.	36.	50.	39.	44.5	11.
15	61.	29.814	64.	29.872	34.	39.	36.5	32.	36.	48.	32.	40.	16.
16	62.	29.970	70.	29.944	39.	40.	39.5	36.	35.	47.	36.	41.5	11.
17	59.	30.000	65.	29.872	38.	45.	41.5	37.	44.	48.	31.	39.5	17.
18	60.	29.750	69.	29.574	44.	42.	43.	44.	42.	46.	41.	43.5	5.
19	58.	29.230	64.	28.972	40.	43.	41.5	39.	43.	46.	39.	42.5	7.
20	56.	29.226	50.	29.508	44.	40.	42.	39.	35.	45.	37.	41.	8.
21	55.	29.344	58.	29.988	37.	37.	37.	34.	34.	46.	34.	40.	12.
22	59.	29.982	58.	29.856	34.	32.	33.	32.	31.	56.	30.	43.	26.
23	58.	29.764	65.	29.772	35.	45.	40.	34.	42.	47.	31.	39.	16.
24	55.	29.790	52.	29.580	37.	37.	37.	36.	37.	49.	34.	41.5	15.
25	58.	29.544	49.	29.754	30.	18.	24.	.....	.....	43.	25.	34.	18.
26	52.	29.830	54.	29.650	18.	27.	22.5	.....	.....	32.	15.	23.5	17.
27	36.	29.192	37.	29.240	27.	27.	27.	.....	.....	27.	23.	25.	4.
28	45.	29.354	52.	29.432	26.	28.	27.	.....	.....	29.	18.	23.5	11.
29	53.	29.368	55.	29.254	24.	26.	25.	.....	.....	34.	22.	28.	6.
30	45.	28.940	52.	29.112	30.	32.	31.	.....	.....	40.	28.	34.	12.
Sum ...	.....	.....	.....	.....	1085.	1138.	1111.5	.....	.....	1421.	939.	1180.	47.6
Mean.	.....	.....	.....	.....	36.1	37.9	37.	.....	.....	47.3	31.3	39.3	15.8

RECORD

LONG. 70° 56′ W. BAROMETER 125 FEET ABOVE SEA LEVEL

November, 1808.	Precipitation.				Prevailing wind direction.	Character of day.	Remarks.
	Time of beginning.	Time of ending.	Total amount in inches.	Snowfall in inches.			
1					S. E.	Clear	Maximum temperature, 61; date, 3d and 4th.
2					S. W.	Clear	
3					S.	Clear	
4				trace	S. E.	Partly cloudy	Minimum temperature, 15; date, 26th.
5	Night.	8 a. m.	.02		S. E.	Cloudy	
6	Night.				S. E.	Cloudy	Mean temperature (mean max. + mean min. ÷ 2), 39.3.
7		Night.	.10		W.	Clear	
8					W.	Clear	
9	Night.				E.	Partly cloudy	Mean temperature (8+8÷2), 37.
10		12 p. m.	1.57	½	N.	Cloudy	
11					N. E.	Cloudy	Mean max. temperature, 47.3; mean min. temperature, 31.3.
12					W.	Partly cloudy	
13	10.45 p. m.				S.	Partly cloudy	Total precipitation, 5.17 inches.
14		6 a. m.	.18		N. W.	Cloudy	
15					S. W.	Clear	Greatest precipitation in any 24 consecutive hours, 1.57; date, 10th.
16					N. W.	Cloudy	
17	11.45 a. m.	6 p. m.	.33		E.	Cloudy	Total snowfall during the month, 15½ inches.
18	9 a. m.				N. E.	Cloudy	
19		11 p. m.	1.26		N. W.	Cloudy	No. of clear days, 7; partly cloudy, 12; cloudy, 11; on which .01 or more precipitation fell, 10.
20					N. W.	Partly cloudy	
21					N.	Clear	
22					N.	Partly cloudy	
23					N. W.	Partly cloudy	Prevailing wind direction, N. W.
24	11 a. m.	Night.	.41		N.	Cloudy	
25					W.	Partly cloudy	Very hard snowstorm and high wind on the 27th and 28th.
26	Night.				N.	Partly cloudy	
27					N. W.	Cloudy	First snow fell on the 10th, about ½ inch.
28		11 p. m.	1.3	15.	N. W.	Partly cloudy	
29					S. W	Partly cloudy	
30					W.	Partly cloudy	
Sum ...			5.17	15.5			

METEOROLOGICAL

DURHAM, STRAFFORD COUNTY, NEW HAMPSHIRE. LAT. 43° 8′ N.

December, 1898.	8 A. M.		8 P. M.		TEMPERATURE.						
	Attached thermometer.	Barometer.	Attached thermometer.	Barometer.	8 a. m.	8 p. m.	Mean.	Maximum.	Minimum.	Mean.	Range.
1	58.	29.324	60.	29.058	32.	30.	31.	34.	29.	31.5	5.
2	55.	29.702	65.	29.884	28.	28.	28.	37.	25.	31.	12.
3	57.	29.990	62.	29.978	19.	32.	25.5	41.	27.	34.	14.
4	50.	29.972	45.	29.660	32.	36.	34.	39.	31.	35.	8.
5	51.	28.976	61.	29.042	39.	35.	37.	44.	34.	39.	10.
6	54.	29.456	60.	29.622	32.	30.	31.	44.	30.	37.	14.
7	58.	29.540	59.	29.656	28.	27.	27.5	38.	26.	32.	12.
8	59.	29.732	58.	29.800	21.	26.	23.5	38.	20.	29.	18.
9	46.	29.856	57.	29.760	14.	18.	16.	31.	11.	21.	20.
10	52.	29.488	58.	29.301	27.	27.	27.	27.	16.	21.5	11.
11	50.	29.076	45.	29.096	29.	27.	28.	32.	24.	28.	8.
12	47.	29.420	46.	29.246	16.	16.	16.	34.	15.	24.5	19.
13	48.	29.482	51.	29.834	14.	01.	25.	18.	01.	09.5	17.
14	46.	30.100	55.	30.030	—5.	+5.	05.	18.	—6.	06.	24.
15	49.	30.136	58.	30.168	17.	17.	17.	20.	12.	16.	8.
16	52.	30.166	58.	30.084	08.	15.	11.5	30.	04.	17.	26.
17	53.	29.958	61.	29.523	15.	28.	21.5	26.	09.	17.5	17.
18	52.	29.554	48.	29.594	28.	54.	41.	34.	21.	27.5	13.
19	50.	29.694	60.	29.726	16.	18.	17.	40.	13.	26.5	27.
20	52.	29.874	58.	29.610	29.	27.	28.	29.	20.	24.5	9.
21	55.	29.616	62.	29.650	50.	53.	51.5	30.	16.	23.	14.
22	60.	29.800	60.	29.662	53.	35.	44.	36.	19.	27.5	17.
23	60.	29.372	63.	29.660	36.	35.	35.5	42.	33.	37.5	9.
24	57.	29.762	65.	29.758	27.	34.	30.5	45.	25.	35.	20.
25	53.	29.858	50.	29.926	22.	25.	23.5	39.	21.	30.	18.
26	47.	29.928	54.	29.700	18.	21.	19.5	35.	14.	24.5	21.
27	47.	29.384	59.	29.300	11.	31.	21.	27.	06.	16.5	21.
28	54.	29.268	51.	29.612	22.	04.	13.	35.	03.	19.	32.
29	51.	29.758	61.	29.690	11.	19.	15.	23.	0.	11.5	23.
30	60.	29.672	67.	29.668	22.	47.	34.5	22.	11.	16.5	11.
31	67.	29.828	59.	30.500	42.	25.	33.5	43.	11.	27.	32.
Sum					763.	836.	794.5	1031.	527.	776.	510.
Mean					24.6	26.96	25.6	33.2	17.	25.	16.4+

RECORD

LONG. 70° 56′ W. BAROMETER 125 FEET ABOVE SEA LEVEL

December, 1888.	Precipitation.				Prevailing wind direction.	Character of day.	Remarks.
	Time of beginning.	Time of ending.	Total amount in inches.	Snowfall in inches.			
1					W.	Partly cloudy..	Maximum temperature, 45; date, 24th.
2					N.W.	Partly cloudy..	
3					N.	Partly cloudy..	Minimum temperature, −6; date, 14th.
4	5.30 a. m.	Night.	1.75		E.	Partly cloudy..	
5					W.	Partly cloudy..	
6					W.	Partly cloudy..	Mean temperature (mean max. + mean min. ÷ 2), 25.1.
7					W.	Partly cloudy..	
8					S. W.	Partly cloudy..	
9					W.	Partly cloudy..	
10					W.	Partly cloudy..	Mean temperature (8 + 8 ÷ 2), 25.8.
11					S. W.	Partly cloudy..	
12	10.30 a. m.	Night.	.31	5.	N.W.	Cloudy	Mean max. temperature, 33.2; mean min. temperature, 17.
13					W.	Clear	
14					S. W.	Clear	Total precipitation, 2.43 inches.
15					S.	Partly cloudy..	
16					S.	Partly cloudy..	
17					W.	Partly cloudy..	
18					W.	Clear	Greatest precipitation in any 24 consecutive hours, 1.75; date, Dec. 4.
19	During night.			1.	N.	Clear	
20		During night.	.04		N.	Cloudy	
21	5 p. m.	9 p. m.			N.	Cloudy	Total snowfall during the month, 6½ inches.
22	During night.	6 a. m.	.37		S. E.	Partly cloudy..	
23					W.	Clear	No. of clear days, 6; partly cloudy, 21; cloudy, 4; on which .01 or more precipitation fell, 8.
24					S. W.	Partly cloudy..	
25					W.	Partly cloudy..	
26					N.	Partly cloudy..	
27					S.	Partly cloudy..	
28					W.	Clear	Prevailing wind direction, W.
29	8 a. m.	11 a. m.	*	.05	S. W.	Partly cloudy..	
30					S. W.	Partly cloudy..	Very high wind on the 28th. Therm. falling to zero that night.
31	8 a. m.				W.	Cloudy	
							Quite heavy snowstorm beginning in rain on 31st, ending in snow on Jan. 1, 1899.
Sum...			2.43	6.5			

* Trace.

METEOROLOGICAL

DURHAM, STRAFFORD COUNTY, NEW HAMPSHIRE. LAT. 43° 8′ N.

January, 1889.	8 A. M.		8 P. M.		TEMPERATURE.						
	Attached thermometer.	Barometer.	Attached thermometer.	Barometer.	8 a. m.	8 p. m.	Mean.	Maximum.	Minimum.	Mean.	Range.
1	54.	30.050	50.	30.176	15.	—4.	5.5	22.	—5.	9.5	25.
2	52.	30.460	64.	30.562	—7.	12.	2.5	17.	—8.	12.5	5.
3	59.	30.200	64.	31.400	17.	25.	21.	28.	17.	22.5	11.
4	62.	29.942	65.	29.818	23.	40.	31.5	43.	15.	32.5	35.
5	68.	29.522	70.	29.986	50.	40.	45.	54.	36.	47.	14.
6	70.	30.064	55.	29.494	29.	20.	24.5	36.	20.	25.	10.
7	65.	29.450	66.	29.564	28.	20.	24.	30.	18.	24.	12.
8	58.	30.049	60.	29.882	25.	23.	24.	33.	15.	24.	18.
9	54.	29.836	60.	29.924	29.	20.	24.5	35.	16.	37.	36.
10	55.	30.100	55.	30.140	1.	—2.	—5.	17.	—5.	6.	22.
11	61.	30.140	60.	30.202	—1.	10.	4.5	15.	—7.	4.	22.
12	55.	30.020	63.	30.206	2.	16.	9.	29.	1.	15.	28.
13	58.	30.184	64.	30.020	8.	29.	18.5	30.	3.	16.5	27.
14	62.	29.784	65.	29.184	32.	33.	32.5	31.	23.	32.	18.
15	53.	29.310	50.	29.732	37.	38.	37.5	42.	27.	34.5	15.
16	59.	29.870	65.	29.732	28.	37.	32.5	38.	26.	32.	12.
17	65.	29.380	69.	29.596	35.	39.	37.	47.	34.	40.5	13.
18	65.	29.764	59.	29.924	22.	15.	18.5	34.	11.	19.	10.
19	60.	30.002	67.	29.992	8.	25.	16.5	34.	6.	20.	28.
20	63.	29.936	65.	29.876	13.	31.	22.	45.	11.	28.	33.
21	63.	29.760	66.	29.460	25.	34.	29.5	43.	24.	33.5	19.
22	61.	29.382	55.	29.500	32.	34.	33.	41.	30.	35.5	11.
23	63.	29.742	72.	29.870	32.	33.	32.5	41.	29.	35.	12.
24	65.	29.672	73.	29.220	32.	35.	33.5	36.	28.	32.	8.
25	65.	29.192	63.	29.690	30.	21.	25.5	31.	16.	26.	10.
26	62.	29.700	70.	29.340	11.	39.	25.	41.	8.	24.5	33.
27	65.	29.292	60.	29.704	24.	7.	15.5	37.	4.	15.	18.
28	55.	29.900	60.	29.576	0.	16.	8.	24.	—2.	11.	26.
29	48.	29.490	44.	29.732	12.	12.	12.	24.	7.	15.5	17.
30	50.	29.768	58.	29.768	4.	12.	8.	23.	2.	20.	6.
31	55.	29.844	55.	29.718	15.	15.	15.	18.	8.	13.	10.
Sum ...					611.	725.	668.	1019.	498.	742.5	564.
Mean..					19.6	23.4	21.5	33+	13.	24.	18+

RECORD

LONG. 70° 56′ W. BAROMETER 125 FEET ABOVE SEA LEVEL

January, 1889.	Precipitation.				Prevailing wind direction.	Character of day.	Remarks.
	Time of beginning.	Time of ending.	Total amount in inches.	Snowfall in inches.			
1	.....	9 a. m.	2.1	10.	N.	Partly cloudy.	Maximum temperature, 54; date, 5th.
2	.....	.....	.....	.....	N.	Clear.	
3	.....	.....	.....	.....	S.W.	Clear.	Minimum temperature,—7; date, 26.
4	.....	.....	.....	.....	S.W.	Partly cloudy.	
5	.....	.....	.....	.....	W.	Cloudy.	Mean temperature (mean max.+mean min.÷2), 23.
6	8 a. m.	Night.	1.7	6.	N.	Cloudy.	
7	.....	.....	.....	.....	W.	Clear.	
8	.....	.....	.....	.....	W.	Clear.	Mean temperature (8+8÷2), 21.5.
9	.....	.....	.....	.....	N.W.	Cloudy.	
10	.....	.....	.....	.....	N.W.	Clear.	Mean max. temperature, 33; mean min. temperature, 13.
11	.....	.....	.....	.....	N.W.	Clear.	
12	.....	.....	.....	.....	N.W.	Clear.	
13	6 p. m.	.....	.....	*	N.W.	Partly cloudy.	Total precipitation, 6.7 inches.
14	.....	.....	.....	.....	N.E.	Cloudy.	
15	.....	6 a. m.	1.3	.....	W.	Partly cloudy.	Greatest precipitation in any 24 consecutive hours, 1.7; date, 6th.
16	8 p. m.	Night.	.7	.....	S.E.	Partly cloudy.	
17	.....	.....	.....	.....	W.	Partly cloudy.	
18	.....	.....	.....	.....	N.W.	Partly cloudy.	
19	.....	.....	.....	.....	W.	Partly cloudy.	Total snowfall during month, 17 inches.
20	.....	.....	.....	.....	S.W.	Partly cloudy.	
21	.....	.....	.....	.....	S.W.	Partly cloudy.	Number of clear days, 7; partly cloudy, 18; cloudy, 6; on which .01 or more precipitation fell, 6.
22	.....	.....	.....	.....	W.	Partly cloudy.	
23	.....	.....	.....	.....	W.	Partly cloudy.	
24	12 m.	.....	.....	.....	N.W.	Partly cloudy.	
25	.....	7 a. m.	.9	1.	N.W.	Partly cloudy.	
26	.....	.....	.....	.....	N.W.	Cloudy.	Prevailing wind, W. N. W.
27	.....	.....	.....	.....	N.W.	Partly cloudy.	
28	.....	.....	.....	.....	S.	Cloudy.	
29	.....	.....	.....	.....	W.	Partly cloudy.	
30	.....	.....	.....	.....	W.	Partly cloudy.	
31	.....	.....	.....	.....	N.E.	Partly cloudy.	
Sum ...	.....	.....	7.7	17.			
.....	.....	.....	.....	.....			

* Trace.

METEOROLOGICAL

DURHAM, STRAFFORD COUNTY, NEW HAMPSHIRE. LAT. 43° 8′ N.

February, 1899.	8 A. M.		8 P. M.		TEMPERATURE.						
	Attached thermometer.	Barometer.	Attached thermometer.	Barometer.	8 a. m.	8 p. m.	Mean.	Maximum.	Minimum.	Mean.	Range.
1	59.	29.388	57.	29.926	9.	8.	8.5	15.	7.	11.	8.
2	55.	29.928	62.	29.904	8.	16.	12.	25.	5.	15.	20.
3	65.	29.944	60.	29.682	13.	22.	17.5	23.	9.	17.	14.
4	58.	29.478	58.	29.736	25.	21.	23.	33.	18.	24.5	15.
5	50.	29.744	45.	29.770	12.	18.	15.	23.	7.	15.	16.
6	55.	29.820	64.	29.750	20.	25.	22.5	30.	16.	23.	14.
7	55.	29.700	64.	29.708	14.	19.	26.5	20.	12.	16.	8.
8	49.	29.392	58.	29.100	11.	12.	11.5	14.	8.	12.	6.
9	58.	29.338	62.	29.458	4.	1.	2.5	10.	0.	5.	10.
10	55.	29.624	56.	29.802	—1.	1.	0.	6.	—2.	2.	8.
11	54.	30.038	56.	30.144	—4.	2.	—2.	5.	—7.	1.	12.
12	51.	30.114	55.	30.008	4.	6.	5.	8.	0.	4.	8.
13	47.	29.742	46.	28.818	6.	10.	8.	16.	4.	10.	12.
14	54.	29.192	59.	29.824	13.	17.	15.	21.	10.	15.5	11.
15	58.	30.184	66.	30.062	2.	26.	14.	32.	3.	17.5	29.
16	63.	30.002	70.	29.832	14.	32.	24.	43.	10.	26.5	33.
17	68.	29.604	74.	29.604	34.	43.	38.5	48.	30.	39.	18.
18	71.	29.644	72.	29.478	38.	36.	37.	51.	28.	39.5	23.
19	62.	29.260	55.	29.524	37.	34.	35.5	43.	31.	37.	12.
20	60.	29.362	73.	29.374	32.	42.	37.	49.	27.	38.	22.
21	70.	29.480	72.	29.516	37.	42.	39.5	52.	32.	42.	20.
22	69.	29.352	65.	29.208	35.	41.	38.	46.	34.	40.	32.
23	66.	29.272	72.	29.444	36.	34.	35.	41.	33.	37.	8.
24	69.	29.614	64.	29.890	23.	25.	24.	30.	20.	25.	10.
25	58.	30.074	59.	30.116	20.	25.	22.5	31.	16.	23.5	15.
26	56.	30.156	48.	29.980	16.	29.	22.5	32.	10.	21.	22.
27	58.	29.552	69.	29.524	37.	37.	37.	42.	29.	35.5	13.
28	58.	29.766	68.	29.633	27.	31.	29.	41.	25.	33.	16.
Sum					522.	655.	598.5	830.	415.	625.5	435.
Mean.					18.6+	23.4—	21.4—	29.6+	14.8+	22.3+	15.5

RECORD

LONG. 70° 56′ W. BAROMETER 125 FEET ABOVE SEA LEVEL

February, 1880.	Precipitation. Time of beginning.	Time of ending.	Total amount in inches.	Snowfall in inches.	Prevailing wind direction.	Character of day.	Remarks.
1					N.W.	Partly cloudy..	Maximum temperature, 52; date, 21st.
2					N.W.	Partly cloudy..	
3	12 m.				N. E.	Cloudy	Minimum temperature, —7; date, 11th.
4		9 a. m.	.4	3.0	N.	Partly cloudy..	
5					N.	Cloudy	
6					N.W.	Partly cloudy..	Mean temperature (mean max. + mean min.÷2), 22.2
7	6 a. m.	9 a. m.		.5	N. E.	Partly cloudy..	
8	5 a. m.	10 p. m.	.5	6.0	N.	Cloudy	
9					W.	Partly cloudy..	Mean temperature (8+8÷2), 21.
10					W.	Clear	
11					N.W.	Partly cloudy..	Mean max. temperature, 29.6+; mean min. temperature, 14.8+.
12	1.15 a. m.				N.	Cloudy	
13					N. E.	Cloudy	
14		5 a. m.	.9	12.	N.W.	Partly cloudy..	Total precipitation, 2.01 inches.
15					S. W.	Partly cloudy..	
16					S. E.	Partly cloudy..	
17					W.	Clear	Greatest precipitation in any 24 consecutive hours, .9 (nearly); date, 13th.
18	During night.		.01		N.W.	Clear	
19					W.	Clear	
20					W.	Clear	
21		*			S. W.	Partly cloudy..	
22					S. W.	Clear	Total snowfall during the month, 21.5 inches.
23					N.W.	Clear	
24					N.W.	Partly cloudy..	
25					N.W.	Partly cloudy..	No. of clear days, 7; partly cloudy, 14; cloudy, 7; on which .01 or more precipitation fell, 9.
26	5 p. m.			*	S.	Cloudy	
27		10.30 a. m.	.2		N.W.	Cloudy	
28					W.	Partly cloudy..	Prevailing wind direction, N. W.
							Heavy snowstorm and very high winds on 13th and 14th; began to snow on 12th; partly cleared toward night, but increased during night and on 13th; clearing early on morning of 14th. Bar. low on 13th and 14th; snow drifted badly, stopping travel on railroad for nearly the 24 hours of 14th.
Sum			2.01	21.5			

* Trace.

METEOROLOGICAL

DURHAM, STRAFFORD COUNTY, NEW HAMPSHIRE. LAT. 43° 8′ N.

	8 A. M.		8 P. M.		TEMPERATURE.						
March, 1899.	Attached thermometer.	Barometer.	Attached thermometer.	Barometer.	8 a. m.	8 p. m.	Mean.	Maximum.	Minimum.	Mean.	Range.
1	76.	29.572	70.	29.760	32.	33.	32.5	43.	30.	36.5	13.
2	66.	29.884	68.	29.868	25.	26.	25.5	30.	20.	25.	10.
3	55.	29.879	73.	29.938	29.	34.	31.5	37.	25.	31.	12.
4	65.	29.880	67.	29.834	33.	33.	33.	36.	32.	34.	4.
5	53.	29.486	51.	29.012	35.	40.	37.5	49.	32.	40.5	17.
6	61.	29.562	69.	29.802	33.	34.	33.5	47.	30.	38.5	17.
7	49.	29.442	59.	29.112	31.	27.	29.	31.	25.	28.	6.
8	60.	29.532	56.	29.844	20.	28.	24.	32.	14.	23.	18.
9	63.	29.962	66.	29.846	17.	26.	21.5	29.	09.	19.	20.
10	65.	30.032	69.	30.124	19.	27.	23.	34.	13.	23.5	21.
11	64.	30.068	66.	29.846	28.	39.	33.5	39.	24.	31.5	15.
12	61.	29.592	60.	29.366	43.	47.	45.	58.	39.	48.5	19.
13	65.	29.672	65.	29.988	39.	31.	35.	42.	27.	34.5	15.
14	60.	30.192	67.	30.244	22.	26.	24.	30.	21.	25.5	9.
15	68.	30.200	57.	29.578	29.	32.	30.5	32.	25.	28.5	7.
16	66.	29.388	59.	29.736	35.	24.	29.5	41.	18.	29.5	23.
17	60.	29.916	56.	29.928	12.	15.	13.5	22.	10.	16.	12.
18	58.	29.914	67.	29.492	15.	32.	23.5	33.	12.	22.5	21.
19	43.	29.174	48.	28.699	28.	31.	29.5	31.	20.	25.5	11.
20	60.	29.544	56.	29.572	27.	24.	25.5	30.	22.	26.	8.
21	60.	29.998	60.	30.082	15.	21.	18.	28.	13.	20.5	15.
22	61.	29.862	53.	29.842	22.	26.	24.	31.	19.	25.	12.
23	52.	29.660	55.	29.468	26.	28	27.	33.	24.	28.5	9.
24	60.	29.568	63.	29.610	28.	27.	27.5	35.	26.	30.5	9.
25	65.	29.634	62.	29.544	23.	25.	24.	31.	14.	22.5	17.
26	47.	29.434	45.	29.592	17.	33.	25.	37.	10.	23.5	27.
27	55.	29.836	64.	29.940	34.	33.	33.5	43.	28.	35.5	15.
28	63.	29.890	64.	29.630	33.	34.	33.5	43.	23.	33.	20.
29	64.	28.764	62.	29.155	41.	30.	35.5	42.	26.	34.	16.
30	66.	29.400	65.	29.562	29.	31.	30.	35.	26.	30.5	9.
31	65.	29.472	71.	29.444	27.	33.	30.	45.	26.	35.5	19.
Sum					847.	930.	888.5	1129.	683.	906.	446.
Mean					27.3	30.	28.6+	36.+	22.	29.+	14.+

RECORD

LONG. 70° 56′ W. BAROMETER 125 FEET ABOVE SEA LEVEL

March, 1899.	Precipitation. Time of beginning.	Time of ending.	Total amount in inches.	Snowfall in inches.	Prevailing wind direction.	Character of day.	Remarks.
1					W.	Clear	Maximum temperature, 58; date, 12th.
2	11.30 a. m.			4.	N. E.	Cloudy	Minimum temperature, 9; date, 9th.
3		8 a. m.	.25		E.	Cloudy	Mean temperature (mean max.+mean min. ÷ 2), 29.
4	6.30 a. m.				N. E.	Cloudy	Mean temperature (8 + 8 ÷ 2), 28.6.
5		12.15 p. m.	.70		S. W.	Cloudy	Mean max. temperature, 36 +; mean min. temperature, 22.
6					N.W.	Clear	Total precipitation, 4.76 inches.
7	7 a. m.	Night.	.35	4.	N. E.	Cloudy	Greatest precipitation in any 24 consecutive hours, 1.5 inches; date, 19th.
8					N.W.	Clear	Total snowfall during the month, 21.5 inches.
9				*	S. E.	Cloudy	No. of clear days, 11; partly cloudy, 5; cloudy, 15; on which .01 or more precipitation fell, 13.
10					S. E.	Clear	Prevailing wind direction, N. W.
11				*	S. W.	Cloudy	Lightning was seen several times on eve of 6th, and during heavy rain on eve of 12th very bright flashes were seen in S. and S.W. and faint thunder was heard.
12	3 p. m.	Night.	.10		S. W.	Cloudy	
13					N. E.	Clear	
14				*	E.	Cloudy	
15	4 p. m.	Night.	.43	2.	S. E.	Cloudy	
16					N.W.	Clear	
17					N.W.	Clear	
18	7 a. m.			4.	S. E.	Cloudy	
19		Night.	1.50		N.W.	Partly cloudy	
20					W.	Partly cloudy	
21					N.W.	Clear	
22	5.30 a. m.	Night.	.25	4.	N. E.	Cloudy	
23	9 a. m.			3.	N.	Cloudy	
24		7 a. m.	.58		N.W.	Clear	
25					N.W.	Clear	
26	7 a. m.	12 m.		.5	N.W.	Partly cloudy	
27					S. E.	Partly cloudy	
28	7 p. m.				S. E.	Cloudy	
29		8 a. m.	.60		W.	Partly cloudy	
30					S. W.	Partly cloudy	
31					S.	Clear	
Sum			4.76	21.5+			

* Trace.

METEOROLOGICAL

DURHAM, STRAFFORD COUNTY, NEW HAMPSHIRE. LAT. 43° 8′ N.

April, 1899.	8 A. M.		8 P. M.		TEMPERATURE.								
	Attached thermometer.	Barometer.	Attached thermometer.	Barometer.	8 a. m.	8 p. m.	Mean.	8 a. m., wet.	8 p. m., wet.	Maximum.	Minimum.	Mean.	Range.
1	72.	29.508	65.	29.488	33.	32.	32.5	32.	32.	39.	27.	33.	12.
2	56.	29.544	55.	29.599	30.	31.	30.5	25.	29.	36.	24.	30.	12.
3	67.	29.670	65.	29.714	33.	36.	34.5	30.	32.	42.	25.	33.5	17.
4	68.	29.814	67.	29.802	35.	35.	35.	31.	32.	44.	28.	36.	16.
5	65.	29.926	68.	29.974	34.	34.	34.	33.	29.	43.	26.	34.5	17.
6	69.	30.088	66.	29.998	37.	35.	36.	31.	33.	51.	28.	39.5	23.
7	66.	29.942	67.	29.838	34.	42.	38.	33.	40.	52	26.	39.	26.
8	60.	29.374	65.	29.310	40.	42.	41.	40.	41.	48.	32.	40.	16.
9	65.	29.292	57.	29.534	42.	36.	39.	39.	34.	47.	33.	40.	14.
10	67.	29.724	67.	29.820	38.	38.	38.	33.	34.	47.	29.	38.	18.
11	64.	30.030	66.	29.982	37.	37.	37.	33.	36.	47.	25.	36.	22.
12	67.	29.832	62.	29.526	39.	34.	36.5	36.	33.	45.	24.	34.5	21.
13	60.	29.508	63.	29.684	45.	45.	45.	40.	40.	51.	30.	40.5	21.
14	65.	29.658	65.	29.544	39.	47.	43.	39.	44.	52.	30.	41.	22.
15	72.	29.662	74.	29.636	52.	46.	49.	47.	40.	59.	32.	45.5	27.
16	60.	29.628	53.	29.472	40.	36.	38.	38.	36.	46.	29.	37.5	17.
17	64.	29.556	66.	29.684	44.	40.	42.	43.	37.	52.	30.	41.	22.
18	71.	29.844	67.	29.840	51.	57.	54.	41.	45.	65.	37.	51.	28.
19	70.	29.964	65.	29.982	47.	40.	43.5	41.	38.	51.	37.	44.	14.
20	70.	30.118	69.	29.962	45.	43.	44.	42.	38.	48.	33.	40.5	15.
21	64.	29.936	60.	29.982	42.	41.	41.5	40.	36.	53.	38.	45.5	15.
22	69.	29.974	64.	29.928	52.	48.	50.	44.	44.	66.	35.	50.5	31.
23	65.	29.864	67.	29.998	62.	59.	60.5	50.	48.	71.	34.	52.5	37.
24	75.	29.968	62.	29.832	52.	49.	50.5	45.	45.	59.	35.	47.	24.
25	72.	29.764	68.	29.744	56.	56.	56.	52.	54.	74.	41.	57.5	33.
26	75.	29.782	65.	29.772	57.	48.	57.5	53.	46.	62.	40.	51.	22.
27	70.	29.920	65.	29.964	51.	46.	48.5	48.	41.	56.	40.	48.	16.
28	71.	29.934	67.	29.882	53.	55.	54.	44.	50.	72.	53.	62.5	19.
29	71.	29.938	75.	29.868	58.	66.	62.	53.	59.	84.	37.	60.5	47.
30	74.	29.878	78.	29.776	63.	71.	67.	56.	63.	86.	51.	68.5	35.
Sum					1341.	1325.	1341.			1648.	989.	1328.5	659.
Mean					44.+	44+	44+			54.9+	32.9+	44.2+	21.9+

RECORD

LONG. 70° 56′ W. BAROMETER 125 FEET ABOVE SEA LEVEL

April, 1899.	Precipitation.				Prevailing wind direction.	Character of day.	Remarks.
	Time of beginning.	Time of ending.	Total amount in inches.	Snowfall in inches.			
1					N.W.	Clear.	Maximum temperature, 86; date, 30th.
2					N.W.	Clear.	
3					N.W.	Clear.	Minimum temperature, 24; date, 2d and 12th.
4					N.W.	Clear.	
5					N.E.	Clear.	
6					S.	Clear.	Mean temperature (mean max.+mean min.÷2), 43.9.
7	9 p. m.			*	S.W.	Partly cloudy.	
8		12 m.	.65		N.E.	Cloudy.	
9					N.W.	Partly cloudy.	Mean temperature (8+8÷2), 44.4.
10					N.W.	Clear.	
11					S.	Clear.	Mean max. temperature, 54.9; mean min. temperature, 32.9.
12	9 a. m.	Night.	.24		W.	Cloudy.	
13					N.W.	Clear.	
14	Night.	8.30 a. m.	.08		S.	Partly cloudy.	
15					N.	Partly cloudy.	Total precipitation, 1.38 inches.
16	3 p. m.	Night.	.23		N.	Cloudy.	
17					N.W.	Clear.	Greatest precipitation in any 24 consecutive hours, 65; date, 8th.
18					N.	Clear.	
19					S.E.	Clear.	
20			*		S.E.	Cloudy.	
21					S.E.	Cloudy.	Number of clear days, 17; partly cloudy, 8; cloudy, 5; on which .01 or more precipitation fell, 6.
22					S.	Clear.	
23					N.	Clear.	
24					S.	Partly cloudy.	
25	7.30 p. m.	Night.	.18		W.	Partly cloudy.	
26					S.E.	Partly cloudy.	
27					S.	Clear.	Prevailing wind, N. W. and S.
28					S.	Clear.	
29					S.	Clear.	
30					S.W.	Partly cloudy.	
Sum			1.38				

* Trace.

METEOROLOGICAL

DURHAM, STRAFFORD COUNTY, NEW HAMPSHIRE. LAT. 43° 8′ N.

	8 A. M.		8 P. M.		TEMPERATURE.								
May, 1899.	Attached thermometer.	Barometer.	Attached thermometer.	Barometer.	8 a. m.	8 p. m.	Mean.	8 a. m., wet.	8 p. m., wet.	Maximum.	Minimum.	Mean.	Range.
1	76.	29.732	76.	29.784	70.	61.	65.5	63.	59.	87.	58.	72.5	29.
2	72.	29.702	67.	29.612	55.	46.	50.5	54.	46.	56.	45.	50.5	11.
3	58.	29.768	64.	29.910	47.	42.	46.5	43.	39.	56.	35.	45.5	21.
4	67.	29.826	65.	29.810	49.	52.	50.5	44.	48.	66.	28.	47.	38.
5	74.	29.982	63.	29.942	50.	48.	49.0	46.	46.	57.	40.	48.5	17.
6	68.	29.968	69.	29.832	55.	60.	57.5	48.	56.	76.	34.	55.	42.
7	72.	29.758	72.	29.724	68.	65.	66.5	59.	61.	79.	45.	62.1	34.
8	63.	29.712	60.	29.696	57.	47.	52.0	49.	46.	63.	47.	55.	16.
9	65.	29.492	63.	29.604	59.	59.	51.0	55.	49.	74.	45.	59.5	29.
10	68.	29.762	67.	29.798	58.	53.	55.5	49.	49.	73.	43.	58.	30.
11	68.	29.678	66.	29.498	61.	51.	56.0	58.	50.	73.	38.	55.5	35.
12	68.	29.518	75.	29.618	59.	62.	60.5	50.	50.	71.	48.	59.5	23.
13	72.	29.732	64.	29.776	63.	54.	58.5	53.	54.	69.	41.	55.	28.
14	63.	29.730	61.	29.718	53.	54.	53.5	42.	49.	65.	46.	55.5	19.
15	60.	29.814	58.	29.776	56.	50.	53.	41.	42.	59.	39.	49.	20.
16	67.	29.768	62.	29.662	52.	52.	52.	45.	46.	60.	38.	47.	22.
17	73.	29.732	62.	29.812	53.	48.	50.5	47.	45.	63.	42.	52.5	21.
18	60.	29.862	55.	29.800	49.	46.	47.5	46.	45.	50.	39.	44.5	10.
19	57.	29.706	63.	29.662	46.	48.	47.	46.	46.	50.	44.	47.	6.
20	59.	29.542	65.	29.562	47.	49.	48.	45.	46.	52.	44.	48.	8.
21	55.	29.542	57.	29.718	47.	48.	47.5	45.	47.	52.	45.	48.5	7.
22	67.	29.832	60.	29.896	50.	46.	48.	44.	44.	58.	43.	50.5	15.
23	61.	29.924	62.	29.920	53.	51.	52.	41.	49.	63.	41.	52.	22.
24	65.	29.982	64.	29.937	59.	55.	57.	54.	52.	72.	35.	53.5	37.
25	68.	29.924	71.	29.850	64.	67.	65.5	56.	59.	75.	40.	57.5	35.
26	71.	29.864	79.	29.770	65.	68.	66.5	61.	59.	80.	49.	64.5	31.
27	70.	29.694	75.	29.606	65.	69.	67.	56.	59.	83.	52.	67.5	31.
28	60.	29.600	64.	29.850	55.	52.	53.5	53.	51.	51.	49.	53.	8.
29	61.	29.902	59.	29.808	54.	50.	52.	50.	50.	56.	47.	51.5	9.
30	61.	29.638	73.	29.584	54.	73.	63.5	53.	59.	81.	48.	64.5	33.
31	74.	29.674	80.	29.626	70.	72.	71.	60.	65.	85.	65.	75.	20.
Sum					1743.	1698.	1722.5	1566.	1566.	2061.	1353.	1707.	707.
Mean					56.2	54.8	55.5	50.2	50.5	66.5	43.6	55.0	22.8

RECORD

Long. 70° 56′ W. Barometer 125 Feet Above Sea Level

May, 1899.	Precipitation.				Prevailing wind direction.	Character of day.	Remarks.
	Time of beginning.	Time of ending.	Total amount in inches.	Snowfall in inches.			
1	7 p. m.	Night.	.46	.....	N. E.	Partly cloudy..	Maximum temperature, 87; date, 1st.
2	.....	.....	.....	.....	S. E.	Cloudy.....	
3	.....	.....	.....	.....	S. E.	Partly cloudy..	Minimum temperature, 28; date, 4th.
4	.....	.....	.....	.....	N. E.	Clear.....	
5	.....	.....	.....	.....	S.	Clear.....	Mean temperature (mean max. + mean min. ÷ 2), 55.
6	.....	.....	.....	.....	S. W.	Partly cloudy..	
7	.....	.....	.....	.....	E.	Clear.....	
8	.....	.....	.....	.....	E.	Partly cloudy..	Mean temperature (8 + 8 ÷ 2), 55.5.
9	.....	.....	.....	.....	N.	Partly cloudy..	
10	5 p. m.	Night.	.12	.....	S. W.	Clear.....	Mean max. temperature, 66.5; mean min. temperature, 43.6.
11	.....	.....	.....	.....	W.	Partly cloudy..	
12	.....	.....	.....	.....	N. W.	Partly cloudy..	
13	6.30 p. m.	Night.	.13	.....	S.	Cloudy.....	Total precipitation, 1.08 inches.
14	.....	.....	.....	.....	N. W.	Partly cloudy..	
15	.....	.....	.....	.....	N. W.	Clear.....	Greatest precipitation in any 24 consecutive hours, .46; date, 1st.
16	.....	.....	.....	.....	E.	Clear.....	
17	.....	.....	.....	.....	S. E.	Clear.....	
18	7 p. m.	.....	.....	.....	S. E.	Cloudy.....	
19	.....	.....	.11	.....	S. E.	Cloudy.....	
20	.....	.....	.04	.....	N. E.	Cloudy.....	No. of clear days, 9; partly cloudy, 14; cloudy, 8; on which .01 or more precipitation fell, 8.
21	.....	Night.	.11	.....	N. E.	Cloudy.....	
22	.....	.....	.....	.....	S.	Partly cloudy..	
23	.....	.....	.....	.....	S. E.	Partly cloudy..	
24	.....	.....	.....	.....	S.	Clear.....	
25	.....	.....	.....	.....	S. W.	Partly cloudy..	Prevailing wind direction, S. E.
26	.....	.....	.....	.....	W.	Partly cloudy..	
27	Night.	Night.	.05	.....	S. W.	Partly cloudy..	
28	.....	.....	.....	.....	E.	Cloudy.....	
29	4 p. m.	Night.	.06	.....	S. E.	Cloudy.....	
30	.....	.....	.....	.....	N. W.	Partly cloudy..	
31	.....	.....	.....	.....	N. W.	Clear.....	
Sum ...	.....	.....	1.08	.....			

METEOROLOGICAL

DURHAM, STRAFFORD COUNTY, NEW HAMPSHIRE. LAT. 43° 8′ N.

	8 A. M.		8 P. M.		TEMPERATURE.								
June, 1839.	Attached thermometer.	Barometer.	Attached thermometer.	Barometer.	8 a. m.	8 p. m.	Mean.	8 a. m., wet.	8 p. m., wet.	Maximum.	Minimum.	Mean.	Range.
1	79.	29.624	81.	29.676	72.	75.	73.5	65.	70	89.	53.	71.	36.
2	85.	29.542	83.	29.622	71.	73.	72.	68.	69	86.	66.	76.	20.
3	80.	29.798	78.	29.718	71.	69.	70.	60.	61	81.	59.	70.	22.
4	78.	29.872	71.	29.716	68.	61.	64.5	59.	58	76.	50.	63.	26.
5	77.	29.724	80.	29.702	75.	73.	74.	70.	68	92.	55.	73.5	37.
6	82.	29.614	82.	29.614	81.	80.	80.5	73.	76	90.	73.	81.5	17.
7	74.	29.722	68.	29.786	58.	54.	56.	56.	52	63.	50.	56.5	13.
8	66.	29.538	81.	29.500	58.	78.	68.	57.	63	89.	51.	70.	38.
9	73.	29.662	75.	29.618	66.	68.	67.	57.	62	77.	62.	69.5	15.
10	70.	29.762	73.	29.772	64.	69.	66.5	50.	54	73.	52.	62.5	21.
11	72.	29.902	73.	29.932	67.	61.	64.	52.	55	76.	45.	60.5	31.
12	73.	29.906	76.	29.826	67.	69.	68.	50.	63	78.	46.	62.	32.
13	78.	29.824	84.	29.730	78.	76.	77.	67.	69	88.	59.	73.5	29.
14	83.	29.690	83.	29.650	78.	74.	76.	72.	70	93.	64.	78.5	29.
15	72.	29.666	68.	29.590	63.	57.	60.	60.	56	69.	56.	62.5	13.
16	72.	29.508	71.	29.732	67.	62.	64.5	65.	55	72.	55.	63.5	17.
17	70.	29.840	73.	29.878	64.	64.	64.	56.	59	74.	52.	63.	22.
18	70.	29.858	74.	29.760	63.	62.	62.5	60.	58	76.	49.	62.5	27.
19	74.	29.686	73.	29.666	68.	62.	65.	60.	60	82.	47.	64.5	35.
20	73.	29.642	73.	29.442	67.	65.	66.	63.	63	82.	47.	64.5	35.
21	71.	29.478	72.	29.634	66.	64.	65.	56.	56	73.	57.	65.	16.
22	68.	29.860	73.	29.964	63.	66.	64.5	50.	58	71.	49.	60.	22.
23	70.	30.000	72.	29.878	64.	66.	65.	58.	58	70.	50.	60.	20.
24	79.	29.840	81.	29.768	75.	74.	74.5	67.	60	90.	57.	63.5	33.
25	78.	29.880	75.	29.770	70.	65.	72.5	66.	64	72.	59.	65.5	13.
26	73.	29.776	76.	29.824	71.	67.	69.	60.	55	80.	54.	67.	26.
27	73.	29.840	76.	29.790	67.	69.	68.	57.	58	79.	45.	62.	34.
28	69.	29.728	66.	29.646	64.	57.	65.5	59.	57	67.	54.	60.5	13.
29	63.	29.624	72.	29.638	60.	68.	64.	56.	53	75.	57.	66.	18.
30	65.	29.734	72.	29.874	60.	66.	63.	48.	55	75.	48.	61.5	27.
Sum....					2026.	1914.	2030.			2368.	1621.	1979.5	737.
Mean..					67.53	63.8	67.6+			78.9+	54.033	65.98	24.5+

RECORD

Long. 70° 56′ W. Barometer 125 Feet Above Sea Level

June, 1899.	Precipitation.				Prevailing wind direction.	Character of day.	Remarks.
	Time of beginning.	Time of ending.	Total amount in inches.	Snowfall in inches.			
1					S.W.	Clear.	Maximum temperature, 93; date, 14th.
2					S.E.	Clear.	
3					N.W.	Clear.	Minimum temperature, 45; date, 11th and 27th.
4					S.	Cloudy.	
5	5.30 p. m.	6.10 p. m.	.03		W.	Partly cloudy.	
6					E.	Clear.	Mean temperature (mean max.+mean min.÷2), 66.46+
7	8 p. m.	Night.	.01		S.E.	Partly cloudy.	
8					W.	Partly cloudy.	
9					W.	Cloudy.	Mean temperature (8+8÷2), 65.6.
10					N.	Partly cloudy.	
11					S.	Clear.	Mean max. temperature, 78.9+; mean min. temperature, 54.03+
12					S.W.	Partly cloudy.	
13					S.W.	Partly cloudy.	
14	3 p. m.	5 p. m.	.08		N.W.	Partly cloudy.	
15	3.45 p. m.	Night.	.28		S.E.	Cloudy.	Total precipitation, 1.14 inches.
16					N.	Partly cloudy.	
17					S.	Partly cloudy.	Greatest precipitation in any 24 consecutive hours, 38 inches; date, 28th.
18					S.	Partly cloudy.	
19	1.15 p. m.	3.45 p. m.	.15		E.	Partly cloudy.	
20	4.35 p. m.	Night.	.15		S.	Partly cloudy.	
21					N.W.	Partly cloudy.	Number of clear days, 7; partly cloudy, 18; cloudy, 5; on which .01 or more precipitation fell, 9.
22					N.W.	Partly cloudy.	
23					S.W.	Partly cloudy.	
24	Night.	Night.	.03		W.	Partly cloudy.	
25	9 a. m.	3 p. m.	.03		S.W.	Cloudy.	
26					N.W.	Clear.	
27					N.W.	Partly cloudy.	Prevailing wind, N. W.
28	12 m.	Night.	.38		S.W.	Cloudy.	
29					N.W.	Partly cloudy.	5th, short, heavy thunder shower, accompanied by very strong wind.
30					N.W.	Clear.	
Sum....			1.14				

METEOROLOGICAL SUMMARY

	Average temperature.		Precipitation.*		Snow in inches.		No. days .01 inch precipitation.		1898–1899.			
	July 1, 1895, to July 1, 1899.	1898–1899.	Average July 1, 1895, to July 1, 1899.	1898–1899.	Average July 1, 1895, to July 1, 1899.	1898–1899.	Average July 1, 1895, to July 1, 1899.	1898–1899.	Prevailing wind direction.	Days clear.	Days partly cloudy.	Days cloudy.
July	69	70	3.97	1.75	.....	.....	10	9	S. E.	12	14	5
August	67	69	3.50	5.92	.....	.....	9	12	S. W.	9	15	7
September	60	61	4.44	3.57	.....	.....	8	7	S. W.	14	10	6
October	48	50	3.77	7.62	.....	.....	8	10	S. W.	8	12	11
November	38	38	5.70	5.19	6.	15.5	12	10	N. W.	7	12	11
December	27	25	3.07	2.43	7.	6.5	7	8	W.	6	21	4
January	21	22	4.07	6.70	20.	17.0	6	6	W. N. W.	7	18	6
February	24	22	3.22	2.01	18.	21.5	7	9	N. W.	7	14	7
March	32	29	4.36	4.76	14.	21.5	10	13	N. W.	11	5	15
April	44	44	2.56	1.38	2.	.....	8	6	N. W. & S.	17	8	5
May	56	55	3.01	1.08	.....	.....	10	8	S. E.	9	14	8
June	64	66	3.84	1.14	.....	.....	10	9	N. W.	7	18	5
Sum	550	551	45.5	43.6	67.	82.	105	107	N. W.	114	161	80
Mean	45.8	45.9										

* Including rain, hail, sleet, and melted snow in inches.

PUBLICATIONS OF EXPERIMENT STATION

The following publications of the station are available for distribution:

No. 2. Feeding Experiments.
No. 3. When to Cut Corn for Ensilage.
No. 4. The Science and Practice of Stock-Feeding.
No. 5. Fertilizers and Fertilizing Materials.
No. 6. Experiments with Fertilizers.
No. 7. Test of Dairy Apparatus.
No. 8. Feeding Experiments. Part 1. Principles of Feeding. Part 2. Corn Meal, Middlings, Shorts, and Cotton-Seed compared.
No. 9. Effect of Food upon Milk.
No. 10. Co-operative Fertilizer Experiments.
No. 11. Pig Feeding. Part 1. Results of Feeding Skim Milk and Corn Meal versus Corn Meal and Middlings. Part 2. Digestion Experiment.
No. 12. Fertilizer Experiments.
No. 14. Ensilage in Dairy Farming.
No. 15. Patent Cattle Foods.
No. 16. Effect of Food on Composition of Butter Fat.
No. 17. Stock Feeders' Guide.
No. 18. Effect of Food on Milk.
No. 19. Spraying Apples and Pears against Fungi.
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No. 21. Farm-yard Manures and Artificial Fertilizers.
No. 22. Prevention of Potato Blight.
No. 23. Some Dangerous Fruit Insects.
No. 24. The Flow of Maple Sap.
No. 25. The Composition of Maple Sap.
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No. 27. Spraying Experiments in 1894.
No. 28. Remedies for the Horn Fly.
No. 29. Remedies for Flea Beetles.
No. 30. An Experiment in Road Making.
No. 31. Seventh Annual Report. 1895.
No. 32. Studies of Maple Sap.
No. 33. Two Shade-Tree Pests.
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No. 37. Crimson Clover.
No. 38. The Tent Caterpillar.
No. 39. The Army Worm.
No. 40. Eighth Annual Report. 1896.
No. 41. Potatoes: Varieties, Fertilizers, Scab.
No. 42. Part 1. Tomato Growing in New Hampshire. Part 2. Notes on Tomato Breeding.
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No. 45. Fruit and Potato Diseases.
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No. 48. Ninth Annual Report. 1897.
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No. 52. Growing Muskmelons in the North.
No. 53. The Farm Water Supply.
No. 54. The Winter Food of the Chickadee.
No. 55. The Feeding Habits of the Chipping Sparrow.
No. 56. Poisonous Properties of Wild Cherry Leaves.
No. 57. Forage and Root Crops.
No. 58. Cost of Raising Calves.
No. 59. Tenth Annual Report. 1898.
No. 60. Green Corn under Glass.
No. 61. Inspection of Fertilizers in 1898.
No. 62. Forcing Pole Beans under Glass.
No. 63. Third Potato Report.
No. 64. The Forest Tent Caterpillar.
No. 65. Notes on Apple and Potato Diseases.
No. 66. Experiments in Pig Feeding.
No. 67. The Spiny Caterpillar.
No. 68. Eleventh Annual Report. 1899.
First Annual Report. 1889.
Second Annual Report. 1890.
Fifth Annual Report. 1893.